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INTRODUCTORY INSTRUCTION IN SPIN CASTING, GOLF, AND ARCHERY: A COMPARISON OF EXPERT, MASSED AND SELF-INSTRUCTION TECHNIQUES

DISSERTATION

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

By

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* * * * *

The Ohio State University
1979

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INTRODUCTION

"The elementary school has long been looked upon as a place for building educational foundations."¹ As such, the physical educator has the responsibility of seeing that a well planned program, leading to the development of useful motor skills, is provided. Knowing that skill development is closely related to social and cognitive development, it seems logical that concise, workable procedures need to be developed to see that actual skill does accrue.² Being able to produce conditions where maximum learning can take place remains the primary task and responsibility of the physical education instructor. Still, the learning of complex motor skill is indeed a process not totally understood and, in specific instances, not understood at all. As such, "... the acquisition of skill is usually a stubborn process."³


Recognizing that new methodologies and styles of teaching need to be developed and tested, if, in fact, identifiable, measurable skills and developmental levels are to be produced, today's elementary school physical education teachers face the awesome task of coping with innovation and rapidly changing societal demands. Anderson further underscores this dilemma as he observes:

For countless years, the teaching profession has made pious pronouncements about individual differences, about the unique value and merit of each individual, and about providing for the needs and welfare of each child. Recent research has revealed how truly great are the differences among and within individuals and has uncovered startling evidence of the great variety in which people can and do learn.4

Education, and specifically physical education, has become child oriented, with modern instruction, practice, and testing procedures set up to expediate the learning process. However, the question of under what circumstances a child learns is left up to the individual instructor. And, in most instances:

... at all stages of learning and performance levels, researchers and educationalists have no reliable information from which to advise the performer what type of practice and how much practice is desirable in order to facilitate the most effective acquisition of skill.5

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As evidenced by the work of Anderson, Elliot, LaBerge, Schurr, and Humphrey, the learning of complex motor skills is vitally important. It has been acknowledged that physical abilities and skills contribute to self-concept and to an ultimate role in life. Jersild adds that "throughout life a person's view of himself is influenced by his perception of his body and its properties, his strength and his skill in physical activities."

In the typical American elementary school, kindergarten through sixth grade, the classroom teacher is most often the planner, co-ordinator, instructor and evaluator of the physical education experience for children. In many cases, this means developing and teaching units of four to six weeks duration, consisting of 30 or 45 minute periods, usually meeting once or twice per week. If in fact, the classroom teacher is going to maximize the usage of instructional time, the development and selection of the most effective teaching techniques becomes of the utmost importance.

Of further importance is the concept that the elementary school is the place to "plant the seeds" for future productive activity. The

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investigator feels that being able to generate success during initial or introductory experiences in complex motor skills increases the likelihood that these skills will be of interest and use in later life. Planning to make maximum use of available time on a short term basis becomes a viable challenge to all teachers of young children. It is with this challenge in mind that the following study has been undertaken.

STATEMENT OF THE PROBLEM

The purpose of this study was to compare three selected groups of 11-12 year old children learning "whole" motor skills under controlled, limited time approaches to teaching. Particular emphasis was placed upon identifying productive methods of teaching children golf, spin casting, and archery skills, during the initial learning phase, in sessions of less than two hours total duration.

QUESTIONS TO BE INVESTIGATED

The initial phase in learning a complex motor skill involves the process of identifying what is to be done, selecting a course of action and then making a response to the selected course of action. As such, effective teaching produces an atmosphere where students can engage in a course of action leading to successful learning. Thus, seeking to produce a high-success-ratio atmosphere in which students could learn, it was desired to determine through experimental measures the answers to the following questions:
1. How important is expert instruction and advice throughout the initial experience of learning a complex skill as compared to self-instruction techniques and brief instruction/practice-only sessions?

2. Is limited time, intensive instruction a viable alternative for introducing complex motor skills?

3. Do distributed, limited time, practice/instruction sessions produce increased performance when compared to short term, intensive instruction periods of comparable duration?

4. Are there differences in the learning rate and final performance of girls and boys receiving practice/instruction in sex segregated classes as compared to coeducational classes?

5. Are there specific differences in the quantity of learning between groups receiving expert instruction, groups learning under intensive practice procedures and groups using self-instructional class settings when total instruction/practice times remain constant?

6. Can specific developmental levels be identified within the limits of the study group?

IMPORTANCE OF THE PROBLEM

Developing methods to enhance achievement levels of elementary school children is a constant, ongoing process. Since this investigation deals with methods used to produce higher initial levels of success, it is intended that the data reveal a confirmation of existing methods or new sound techniques for maximizing use of available time, student grouping and instructional resources.
A basic tenant of many researchers is that success builds
interest while interest maintains or increases motivational levels
which in turn may lead to further seeking in the area of initial suc­
cess.

It has been demonstrated, however, that performance and
effect do not necessarily go hand in hand. Educational treat­
ments that significantly increase task interest have been found
to have at most, a trivial effect on task performance.9

Thus, methodology becomes vitally important in insuring an identifiable
increase in motor performance. Realistically, scientifically developed
foundations are a necessity in producing future lifelong participants.

In that the selected skills in this study (archery, spin casting
and golf), are often categorized as being "lifetime sports", being able
to produce maximally successful early experiences is highly desirable.

As Slusher states:

"Sport provides the challenge of existence, the situation
for attainment of high level being. It lets you know how good
you really are. Man learns to determine his existence - to find
what he has."10

The methods developed in this study are sought to provide teachers with
functional approaches to introducing complex motor tasks. Oberteuffer
and Ulrich further stress that:

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9Margaret M. Clifford, "How Learning and Liking Are Related -

10Howard S. Slusher, Man; Sport and Existence: A Critical
Modern education includes physical education as a part of curriculum, and therefore physical education as an educational experience is expected to make its contribution to human development.11

This study is intended as an avenue for finding new paths leading towards increasing and developing human potential. Drowatzky, Oxendine, Singer, Lawther and others indicate that in the early stages of learning motor tasks, short practice periods prove most efficient (amount of improvement per unit of practice).12 Yet, a review of literature reveals gaps in this research/methodological sequence which leaves teachers to make empirical decisions about how to approach initial phases of learning a complex motor skill. How long, how much and what kind of learning sessions are largely unanswered in current approaches to introducing sports skills including golf, spin casting, archery and many others.

Acquisition of skill is often used as a prime attractor to youths and their parents by sport clinicians, camp directors, teachers and coaches. In fact, the short term, intensive study, packaged approach to learning new skill is currently in vogue. As such, it is important


to note that very little research is available that measures the productivity of short term instruction/practice techniques. In 1965, Singer reported that:

Very little work may be found in the experimental literature relating to the distribution of practice effects on the learning and retaining of gross motor skills; or more specifically, athletic skills.  

Unfortunately, this gap is still currently in existence. Singer strongly suggests further research in the above area.  

This study should provide elementary school physical educators with tested means by which decisions can be made as to how to start youngsters learning golf, archery and spin casting skills.

Finally, providing situations where equal opportunities for sexes to learn physical skills is a necessity demanded by both common thought and actual statutory law. Learning about the conditions under which boys and girls learn complex skills can also be of assistance in planning future class groupings.

BASIC ASSUMPTIONS

1. In that the intrinsic feedback capacities are relatively high and immediately available to the subjects from the chosen skills.

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13 Singer, "Massed and Distributed Practice Effects on the Acquisition and Retention of a Novel Basketball Skill," ibid., 68-77.

14 Ibid.

It was assumed that the subjects should receive adequate reinforcement concerning their performance. Subjects were encouraged to do their best at all times and to challenge themselves to improve as much as possible. No artificial feedback system was used to enhance performance.

2. Testing procedures and practice were the same for all subjects.

3. Each subject is capable of performing the specific task presented.

DEFINITION OF TERMS

1. Motor task—any repeatable movement or series of movements used to accomplish a cognitively stated goal.16

2. Motor learning—improvement in proficiency on a motor skill that is due to experience or practice conditions rather than to maturational processes or temporary motivational and physiological fluctuations.17

3. Motor skill—any muscular activity that is directed toward a specific objective. Large muscles = gross motor skills; small muscles = fine motor skills on a continuum.18

4. Clinic—a class meeting devoted to the analysis, practice and learning of specific motor tasks.


17 Ibid., p. 7

18 John D. Lawther, op. cit., p. 2.
5. Whole skill - a series of movements which added together culminate in an identifiable, singly labeled act, i.e. shooting an arrow or a full swing in golf.

6. Initial experience - refers to the first exposure to a task to be accomplished in the school curriculum.

7. Learning - a relatively permanent change in behavior resulting from training and experience. It is a process of adaptation. Learning is commonly inferred to either occur or not occur from one's performance.19

8. Limited time/short term - used synonymously to indicate total instruction/practice sessions of less than 120 minutes duration.

19Ibid.
Developing successful techniques for teaching motor tasks becomes the ultimate challenge to all who are interested in creating the best possible atmosphere in which children may attempt the learning of physical skills. As such, new research is faced with the tasks of integrating, interpreting, and synthesizing from learning research conducted both in highly controlled laboratory settings and educational or applied research settings conducted more frequently in the school or other public forum. As this study deals with motor learning as it relates to specific skill development, the writer recognizes the dearth of literature in the motor learning area. Therefore, the review of literature will be limited primarily to research dealing with initial phases of learning motor tasks and, secondarily, to research illustrating current scientific knowledge of the process of learning.

Thus, the review of literature will consist of the following sections: (1) theoretical constructs and models for learning: a historical review, (2) recent tenants in educational, motor learning methodology, (3) factors affecting skill acquisition and retention, and (4) research involving limited time, practice/instruction techniques.
Although the reasons why we learn or why we do not learn are not clearly understood, the process of learning is vital to our daily lives.¹ When dealing with human learning processes, one quickly recognizes that heredity and environment, without question, blend to modify human behavior. Espenschade and Eckert state that:

Environment from the moment of conception modifies and interacts with heredity to shape the individual and to control the extent to which the maximum potential will be realized. It is difficult, if not impossible to assess the relative contributions of heredity and environment.²

Thus, researchers for decades have sought to identify and enhance those controllable factors which influence learning. As a result, a number of learning theories have been presented as theoretical models.

One can begin to validate the intensive beginnings of the modern scientific approach to instruction as taking root during the late 1800's and early 1900's. The writings of William James, John Dewey, Edward Thorndike, G. Stanley Hall, Alfred Binet, and others, have had a profound effect on current methodological investigation.³

Evolving from these early theoreticians is the continual thread that "the teacher must strive to employ the right proportion of

direct teaching and nurture of receptivity and creativity. Developing a rational order for learning remains tantamount to producing successful learning situations.

Adler, as a 1941, modern exponent of the Aristotelian philosophy, emphasized the difference between the order of knowledge and the order of learning as follows:

Today, in most cases, teaching proceeds as if the order of teaching should follow the order of knowledge, the objective order of knowledge itself, even though we know that this objective cannot be followed in the process of discovery. In fact, it is completely reversed. Instruction which departs from the order of discovery also departs from the order of learning, for the way of discovery is the primary way of the mind to imitating discovery. The objective structure of knowledge in no way indicates the processes of the mind in growth.

Historically, the search for designs to maximize learning potentialities produced many models and theories. Thus, it is felt worthwhile to review several of the major works to add insight to the current conceptual approaches to learning and teaching.

Robb states that:

Traditionally learning is divided into three categories: (1) cognitive, (2) affective, and (3) effective learning. Although each category can be distinguished by the kinds of learning achieved or the area most influenced, the process which underlies all types of learning appears to be the same.

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As each theory of learning differs in some aspect from every other, generally, each can be classified into either of the broad categories of associationist or Gestaltist. The greatest contrasts are found between these two schools -- the traditional associative, or conditioned response theories of learning, proposed initially by Hohann Friedrich Hebart and later scientifically developed by Pavlov and B. F. Skinner, and the Gestalt or "field" points of view, expounded on by Max Wertheimer, Kurt Koffka, Wolfgang Kohler and Kurt Lewin. At one end were psychologists who considered learning to be the result of a bond-connecting process. At the other extreme, learning was believed to be the result of an insight through which relationships are revealed.

The contributions of American educational psychologist Edward L. Thorndike to a science and technology of instruction were monumental... Out of Thorndike's studies with animals had come the first scientific theory of learning, his theory of connectionism. Whereas previous theories had emphasized practice or repetition, Thorndike gave equal consideration to reward or punishment, success or failure, and satisfaction or annoyance to the learner.

Basing his theory on the concept of the reflex arc, which connected the brain and the neural tissue with the total behavior of the organism, Thorndike formulated laws of learning which provided basic principles

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7Saeltier, loc. cit.


9Saeltier, op. cit., pp. 49-51.
leading to a technology of learning. The most noteworthy of these principles are important in developing a conceptual understanding of the complexity of the learning process. They are as follows:

1. The law of exercise or repetition. According to this law, the more times a stimulus-induced response is repeated, the longer it will be retained.

2. The law of effect. The law of effect states the pleasure-pain principle. A response is strengthened if it is followed by pleasure and weakened if followed by displeasure.

3. The law of readiness. Thorndike assumed that because of the structure of the nervous system, certain condition units, in a given situation, are more predisposed to conduct than others.

According to the connectionist conception, the instructional task of the teacher would be guided by two broad rules: (1) to put together what should go together and (2) to reward desirable connections and make undesirable connections produce discomfort. The experimental work of Herman Ebbinghaus, 1850-1909, Ivan P. Pavlov, 1849-1936, and Vladimir M. Bekterev, 1857-1927, during the nineteenth century replaced the association of ideas by association of stimuli and responses.

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10 Ibid.


12 Ibid.

13 Saeltier, op. cit., p. 51.
Furthering man's understanding of the learning process while questioning Thorndike's reflex arc theory, American psychologist John Dewey proposed that stimulus and response were not to be sharply distinguished but were to be seen always as organically related. Thus, Dewey's reflective method of instruction, 1896-1910, gave impetus to a lasting effect on American education and many current theories of how human beings learn. Developing philosophical and psychological conceptions about how man learns became the focus for much of Dewey's life. The need for a more adequate theory and practice of schooling, in Dewey's view, had become an urgent requirement in the closing years of the nineteenth century. Thus, Dewey's theory of schooling must be understood within the context of his requirements for the development of the educated man.

First it must be based upon a diagnosis of social conditions which reflects a sound and complete interpretation of the current situation. Secondly, it must be consistent with interrelated theories of human experience and its various aspects of behavior, thought, judgement and relationships — with theories of psychology, logic, ethics, and social philosophy — which themselves consistently reveal the possibilities for the solution of the problem and offer support and guidance to the effort. Dewey's efforts to develop a conceptual model for instruction challenged generations of investigators as they sought to improve educational procedures and products.

Thus, Dewey's reflective method of instruction, 1910, Thorndike's laws of learning, 1913, Pavlov's classical conditioning as

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15 Ibid., p. 174.
a learning process, 1934, B. F. Skinner’s instrumental conditioning, 1938-1953, Tolman’s Gestalt expectation, 1942, and many others have developed an ever expanding framework within which modern educators strive to develop curriculum materials. Drowatzky further emphasized the actual integration of many theories of learning into the lives of modern man when he stated that "most of us, if our developmental level is sufficient, use classical, instrumental, and cognitive learning styles during our lives." The works of Kephart, Piaget, Espenschade and Eckert, and D. O. Hebb illustrate that:

Once concepts and perceptions have been formed through classical and instrumental conditioning, cognitive styles of learning are used. The two forms of conditioning are the predominant styles of learning used for the first twelve years of life, and the quick cognitive style is most prevalent thereafter. Our responses are guided and selected from information provided in current situations by cognitions, such as attitudes, expectations, motivations, and the like.

As learning has been described as the relatively permanent change in behavior, resulting from experience or some type of practice; it is a process of adaptation. Motor learning is learning that is evidenced through muscular responses that are generally expressed in the movement of one's body or body parts.

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17Drowatzky, op. cit., p. 31.

18Ibid., pp. 37-38.

19Ibid., pp. 31-38.
One cannot separate motor learning from any of the previously mentioned theories of learning. The only distinction to be made is that of function. In fact, being able to distinguish purposeful movement of any kind is the only way one can validate whether learning has occurred. As the intent of this review is to develop new understandings of conditions through which children learn motor skills, it is felt necessary to propose that if there is a new interest in theories of learning, it is because the tremendous changes in our society have given us the task of preparing children to live in a very different society from what we have had in the past. As such, the writer turns his attention to synthesizing and illustrating recent tenants in educational motor learning teaching methodologies.

RECENT TENANTS IN EDUCATIONAL MOTOR LEARNING METHODOLOGY

Although extensive work has been devoted to research dealing with how one learns, little has been translated into systematic, highly reliable teaching methodology. For a program of physical education to be of value in a school, it must be a well planned program that meets the needs and interests of the total population which it serves. As such, professional physical educators for decades have striven to develop instructional objectives to be introduced through carefully selected

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20Learning and Mental Health in the School, Association for Supervision and Curriculum Development, NEA, Washington, D.C., 1966
learning activities and, whenever possible, controlled learning environments. Behind the teaching of each of these objectives is usually a conceptual framework for instruction. It is to these approaches to instruction that we now turn our attention.

In order to begin a systematic review of theoretical models for the acquisition of motor skill, it is felt prudent to put into perspective the need to study skill learning in natural settings. Freud, Lewin and Murray, educational psychologists and motivational theorists, agree that behavior is to be explained by discovering the underlying forces that make it happen.\(^{21}\) Duncan and Wishner further underscore this need as they state that:

Human needs have often been reduced to and studied as observable behavior in rats, cats, and other nonhuman subjects. Thirst, hunger, sleep, frustration, stress, sensory deprivation and other studies offer little to teachers seeking means of motivating students. Only studies of actual situations in skill development will produce ways of increasing desired behavior.\(^{22}\)

Fitts, 1961, suggests that out of this concern to develop applicable teaching theories have come three types of models which are stimulating much of the contemporary work in motor skill learning:

1. Communications models.

...Information and communications concepts are now being applied to many kinds of processes and can easily be extended to models of skilled performance...Thus skilled perceptual-motor


performance can be viewed as involving operations such as information translation, information collation, and in some cases the generation of information.\textsuperscript{23}

2. Control system models.

The most generally used control system concept is that of feedback...The nature of the feedback function is tantamount to making actual skill behaviors or predicting performance.\textsuperscript{24}

3. Adaptive system models.

Adaptive system models assume that learning is an adaptive process...Basic to the adaptive system is the existence of hierarchical processes. Programs are provided for carrying out basic or routine functions, and other, higher level programs or plans.\textsuperscript{25}

Skinner, 1953, felt that:

The whole process of becoming competent in any field must be divided into a very large number of very small steps and reinforcement must be contingent upon the accomplishment of each step...By making each step as small as possible the frequency of reinforcement can be raised to a maximum, while the possible aversive consequences of being wrong are reduced to a minimum.\textsuperscript{26}

Marteniuk, 1972, additionally, reflects that:

Motor skills are hierarchically organized in that several small component parts of a skill are grouped under a larger component part. In turn, several larger components may be


\textsuperscript{24}\textsuperscript{Ibid., p. 249.}

\textsuperscript{25}\textsuperscript{Ibid., p. 250}

grouped under yet a larger one.27

As a result of the previous influence, much effort has been dedicated by professional educators towards the development of programmed learning experiences. Yet, as Lawther clearly reports:

We know that changes in responses occur after meaningful experience or motivated practice both the physiological basis of this learning can still be described only hypothetically.28

Adams, 1967, concluded that most learning theories of past and present are primarily open-loop oriented. That is to say that an open-loop system has no feedback or mechanisms for error regulation.

If stimuli are adequate, and the motivational and habit or perceptual states of the organism are sufficient, the response will occur, otherwise not. Regulatory adjustment of the organism by feedback from the response output is usually not considered.29

Thus, Adams, 1971, suggested that the close-loop system, which has as its elements feedback, error detection, and error correction, was a concept to be further explored as a model of how learning proceeds.30

In his model, environmental as well as internally generated stimuli interact to produce a selected response to a problem rather than a programmed or predetermined response. Knowledge of results, or more commonly known as feedback, becomes unquestionably a determiner of


30 Ibid.
human performance. To Adams, motor learning is perceptual, cognitive and personally controlled in a rational manner. To regard motor learning as only a mechanical process would be grossly in error. Brown and Cratty further underscore the need for using a system which encourages feedback as they state "educators have demonstrated repeatedly that learning is impeded unless the learner receives some knowledge about his performance."31 They further state that "skill acquisition involves the continual use of kinesthetic feedback and memory to assist in the production of a consistent pattern."32

Reacting to the dearth of product-oriented research currently in vogue in modern learning, Stelmach reflected that:

It seems that most of our theories have been primarily interested in explaining the course of learning as a function of practice (Adams) (Gentile) (Schmidt). That is they focus on the systematic changes in behavior that occur as a consequence of experience.33

Perhaps most perplexing to anyone who studies the process through which humans learn, is the realization that it is very possible that much of the higher level cortical activity that controls the motor functions of human beings may very well defy analysis for years to come. According to Stelmach, "...current theoretical orientation of motor behavior

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32Ibid., p. 47.
33George E. Stelmach, "Toward an Information Approach in Motor Behavior Research" (paper presented at the joint meeting of the National College of Physical Education Association for Men and the National Association of Physical Education for College Women, Orlando, Florida, January 7, 1977), p. 9.
research toward information processing is only at the descriptive level."\textsuperscript{34}

In considering the results of both product-oriented motor learning research and process-oriented research, one must still recognize that there is a very definite need to identify and formulate productive teaching methodologies. At some point in time it becomes necessary to put theory into functional practice. Stephens, 1967, comments:

Every so often we adopt new approaches or new methodologies and place our reliances on new panaceas...Yet the academic growth within the classroom continues at about the same rate, stubbornly refusing to co-operate with the bright new data emanating from the conference room.\textsuperscript{35}

Thus, the state of teaching methodology related to the understanding of how one learns a motor skill is currently subject to much conjecture yet at a stage where at least initial facts can be described.

Johnson and Johnson, 1974, suggest that "theories of instruction are prescriptive, in that they set forth rules concerning or specifying the most effective way of achieving knowledge or mastering skills."\textsuperscript{36}

It is to these generally agreed upon rules that the writer turns his attention.

\textsuperscript{34}Ibid., p. 12.


\textsuperscript{36}David W. Johnson and Roger T. Johnson, "Instructional Goal Structure: Cooperative, Competitive or Individualistic," Review of Educational Research, XLIV, No. 2 (Spring, 1974), 213.
LONG AGO RESEARCHERS BEGAN TO REALIZE THAT THE ACQUISITION OF skill was a process not totally understood by the learner or the teacher. Yet, both learner and teacher were actively involved in the educational process. Charles Bowdlear, 1930, aptly stressed the necessity of getting involved in the learning process when he stated:

Man would be at a decided disadvantage if he could not learn by trial and error since often the thing he has to manage is very difficult to learn through rational analysis. Much motor skill is acquired by doing the best you can; getting into trouble, varying your procedure, and gradually "getting the hand of the thing" without ever seeing what are the conditions of success.37

It is the writer's belief that mastering skills is a doing proposition. It is one that can be studied through the recognition and measurements of beginning and end performances. Yet to say that a casual relationship exists between a single means of learning, i.e. a method, and the end product for the learner can often be misleading. Lockhart and Johnson, 1977, elaborate as follows;

The acquisition of skill depends on the learner himself, the way he is taught, the way he practices, the conditions under which he practices, and the nature of the thing he is trying to learn. The learner's readiness to learn depends on his maturational level, his experiential background and his motivation.38


In that this study deals with methods which allow varying lengths and styles of teaching and practice sessions, a review of research relating to effects of practice offers much material for thought to those who design programs for skill acquisition.

Since the acquisition of skill depends a great deal upon the receptivity of the learner, Allen and McDonald, 1962, hypothesized that "self organization of instructional materials by the learner will improve both his rate of learning and the amount he learns." Unfortunately, the results of their work indicated that "performance is significantly lower when the student completely controls the organization of instruction materials." Although primarily studying a cognitive exercise in learning through the game of checkers, Allen and McDonald concluded that students needed some assistance to cue in on as to what it is they were going to learn. The question of how important teacher input at various stages of learning (beginning, middle, or later) remained unclear in their study.41

A great deal of research has been done on the effects of practice upon performance and intellectual tasks concluded that while: (1) a practice period was found to be more effective than repetition of the


40Ibid.

41Ibid.
training in improving performance; no such difference was obtained on the intellectual task; and, (2) performance on the intellectual task was positively related to intelligence, but this was not the case for the manipulative tasks.\(^{42}\)

The mirror tracing study by Oxendine, 1965, concludes that:

In the early stages of the learning period, short practice periods prove most efficient (amount of practice per unit of practice) for skills used in the study...A short warm-up is needed to overcome the decrement from the previous practice period.\(^{43}\)

This study typifies the research efforts of many investigators during the 1960's. Much effort was being made to critically analyze the process of learning and reflected work done under highly controlled laboratory conditions. While little was being done to translate those ideas into usable "field" situations. In fact, Singer, 1965, observed that:

Very little work may be found in the experimental literature relating to the distribution of practice effects on the learning and retaining of gross motor skills; or more specifically, athletic skills.\(^{44}\)

Later works by Lawther, 1968, Drowatzky, 1970, and Flinchum, 1975, generally indicate that distributed practice conditions are superior to

\(^{42}\)Thomas F. Hull, "The Effects of Practice on the Performance of Task Analyzed Operations," *Journal of Industrial Teacher Education*, III (Fall, 1965), 4-9.


massed practice for beginning performers. However, much work remains before one can easily determine how much and how often beginning learners should practice particular skills. Flinchum, 1975, suggested that practice may be the one most important factor in the attainment of motor skill.

In addition to practice, a variety of factors influence the process of learning motor skills. Sullivan, Schultz and Baker, 1971, studying effective means of supplying learners with KR (knowledge of results) suggested that improvement in instructional materials may not result in corresponding increases in learner achievements unless an effective reinforcer is available for acceptable achievement. However, recalling an earlier quote, Clifford, 1973, reminds us that:

...Performance and effect do not necessarily go hand in hand. Educational treatments that significantly increase task interest have been found to have at most, a trivial effect on task performance.

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46 Flinchum, op. cit.


Of basic importance seems to be the agreement between many researchers that learning proceeds more quickly when the learner is provided a means of indicating what progress he is making.

Johnson, 1968, reacting to the increasing use of video-tape film and slide presentations used in the educational setting, found through her research a significant increase in viewer performance when scenes were accompanied by a program that provided intermittent prompting, overt practice and immediate knowledge of results.\textsuperscript{49} Curriculum implications dictate that the teacher plan means of insuring both spaced instruction and systems of immediate feedback. Fortunately, many physical skills have intrinsic means of giving the performer an idea of how well he has performed. The previously mentioned study by Johnson also illustrates the importance of designing materials that allow for idea formation, practice and then the provision of a testing situation where the learner can measure achievement.

It is interesting to note that in much research reviewed by the writer, teacher input played a key role in concept formation and ultimately learner performance. Teacher behavior was formulated as information processing by Ryans, 1963. The information processing was, hypothesized to involve a five phase sequence of activities:

(1) Sensing, identifying, and classifying input.

(2) Evaluation of possible course action.

(3) The making of decisions by the teacher.

(4) Programming or logical psychological ordering and arranging of information output.

(5) Transmission of appropriate information to the pupil.

Gage and Unruh, 1967, commenting on the teaching act, indicated that in both live and programmed instruction the teaching-learning process:

...Exhibited a repeated sequence of (a) structuring (b) presentation of ideas (c) solicitation of a response (d) response by the learner and (e) reaction to the response.

Thus research repeatedly stresses the importance of adequately preparing teachers who understand their role in structuring the learning process. Although it is generally accepted that teachers play an important role in student learning, the student himself plays the major role in the learning process. A large number of intermittently occurring factors influence his progress.

For instance, timing in the presentation of material to students plays a key role in how much and how quickly skills are learned. Dinkmeyer and Dreikers, 1963, stresses that "part of teaching consists of being alert to what the child is currently able to achieve."

Positive methods will dominate the teacher's relationship with children in an atmosphere that is encouraging and stimulating.

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Children will function more efficiently because they will regularly be presented with appropriate tasks.\(^{53}\)

Both Lawther, 1968, and Corbin, 1970, felt that early in life was the best time in life to learn skills.\(^{54}\) Lawther further pointed out, however, that:

> Effective methods of teaching change with the level of learning of the learner himself. The methods for the lowest levels require patience and understanding of both (1) the extra time factor and (2) the quantity-of-experience factor.\(^{55}\)

Corbin, 1970, further suggested that skill must be overlearned. A common mistake made in skill learning is to assume that once a skill is performed correctly that it is mastered.\(^{56}\) Corbin further suggested that students first learn skill technique, then accuracy; "accuracy will develop as 'proper' technique is overlearned."\(^{57}\)

Huntinger and Bruce, 1971, illustrated the importance of verbal modeling in a study of thirty six children assigned to six experimental conditions in a design which varied adult verbal modeling and feedback.\(^{58}\)

\(^{53}\)Ibid.


\(^{55}\)Lawther, ibid., p. 13.

\(^{56}\)Corbin, op. cit., p. 74.

\(^{57}\)Ibid., p. 75.

Children given adult verbal modeling "produced significantly more adjectives, placed them correctly more often, and produced more grammatically complete sentences than Ss (subjects) given no model." Verbal input thus becomes a factor capable of influencing the process of learning. Commenting on the effects of feedback, Huntinger and Bruce found that "children who learned to discriminate were consistently superior over children given indiscriminate praise." 

Clifford, 1972, tested the assumption that a competitive situation can arouse and sustain class interest for the duration of the learning task and that classroom learning is a function of interest. Interestingly, her findings showed performance increase did not occur in spite of an apparent difference in motivation. Task difficulty and intrinsic task reinforcement seemed to predict final outcome. This study further reinforced the writer's belief that emphasis must be placed upon selecting, for the learner, skills which are not only captivating to the learner's interest but which also are intrinsically motivating. Theories of motivation and motivational techniques play a key role in how the young learner perceives the worth of the task he undertakes.

Teaching techniques and methods also influence skill acquisition and retention. Singer and Dick add perspective as they state:

59Ibid., p. 620.
60Ibid., p. 622.
If we were to examine all possible approaches to teaching, based on common sense, teaching models, learning theories, and research, we would become either discouraged or encouraged. Perhaps one of the major problems in the past was the attempt to determine 'one right way of teaching,' as if such existed. A more realistic stance would be to appraise a particular approach to teaching according to the instructional goals and the kinds of students involved. It is not a question of good or bad on an absolute.62

Of particular importance to the understanding of factors influencing skill acquisition is the concept that skill learning may proceed in a hierarchical manner. Once a response is made it has the possibility to be strengthened through available reinforcement. Most beginning attempts at learning specific skill patterns exist first as only approximations of the complete or mature pattern. The process of moving from the first approximation to the final product offers a number of methodological possibilities.

Staats, 1966, reported that "the process of successive approximation seems to occur in much expert coaching, where finer and finer responses are differentiated out of the former class or grosser variations."63 Strengthening through various reinforcement techniques becomes important in shaping the next approximation. Staats further pointed out that "human behavior is often not so simple that a stimulus situation tends to elicit only one response or one chain of responses."64 Determining whether or not one has acquired skill reflects an


64Ibid., p. 101.
understanding of the exact appearance of the final product. That understanding is based upon what approximations went before. As White and Taylor, 1970, suggested:

One of the major problems in the study of skilled behavior is to determine what changes occur within the complex sensory-motor task and his final polished performance.  

Siedentop, 1972, in describing a model which reflected successive approximation, offered the following model for teaching a new behavior:

1. Determine the terminal behavior.
2. Determine one or more significant reinforcers.
3. Determine a successively more approximate set of criteria (the sequence of steps) for each behavior or behavior segment.
4. For complex skills, such as swimming, determine the appropriate sequence for teaching the segments and their amalgamation so that the skill will be built efficiently.
5. Determine methods for administering contingent reinforcement.
6. Determine the reinforcement schedules and desired behavior strengths for each step.
7. Determine the reinforcing schedules for establishing the terminal behavior.
8. Determine procedures for developing stimulus control.
9. Prime the behavior segments or the behavior itself.
10. Reinforce each step.
11. Apply the terminal schedule when the program is complete.
12. Appraise the terminal behavior periodically and reinstitute shaping procedures and terminal schedule when necessary.

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66Ibid., p. 343
Thus Siedentop suggested that the hierarchical structure of all skills must be analyzed and understood in order to give instructions for each phase of learning when dealing with motor tasks.

Interest in learning factors such as research in cognitive processes of attention, encoding, search and rehearsal strategies offer further speculation as to how humans learn. Harcum, 1975, spoke of the learner "as an information processor who is equipped with learning programs." Bower, 1970, further elaborated by stating:

The first general idea is that a preferred strategy of the adult human in learning a large body of materials is to 'divide and conquer' that is, subdivide the material into smaller groups by some means, and then learn these parts as integrated packets of information. The basis for the groupings can be richly varied depending upon the nature of the material and the person's mental set.

Robb, 1972, offered several theories as to how people retain information and she grouped retention theories into three categories:

1. Interference Theory: Based on the assumption that forgetting occurs because the stimulus fails to maintain a relationship with the response.
3. Repression Theory: Explains retention as a result of emotional content associated with material to be retained.

Robb further supported the concept that sequential ordering is of importance in learning and suggested that:


There seems to be a relationship between retention and task integration and organization. And, there is some indication that the sequence of the various subroutines in a movement pattern is more easily retained than the temporal patterning.\textsuperscript{71}

Levin and Allen, 1976, offered detailed analysis concerning what we have learned about maximizing what children learn. In summary, they suggested that:

1. In a large number of learning tasks, children seem to learn better when materials are pictures than when materials are words...
2. There appears to be limitations to the effectiveness of pictures in terms of both learner and task differences. With regard to the learner, we have found that certain children learn appreciably better from pictures than from words and, for these children, the type of materials presented during learning largely determine whether they will resemble good or poor learners.
3. Subject-generated organizational strategies (visual imagery in particular) greatly facilitate associative learning. The ability to generate effective imaginal organizations appear to be closely related to the cognitive-developmental level of the learner.\textsuperscript{72}

Thus, the suggestion that pictures are more effective than words remains as an important research problem. The questions: can pictures be compared with live demonstration from a model and does learning become more effective when both work and picture association begin to have near equal meaning remain unanswered.

Lombardo and Catalano, 1975, studied the effect of failure and the nature of the audience on performance of a complex motor task, in an attempt to resolve conflicting findings that an audience sometimes facilitates and sometimes impairs performance. Their study indicated

\textsuperscript{71}Ibid., p. 76.

that audiences who make high quality performance judgements, i.e. react positively or negatively to acts of the performer's drive to excel.\textsuperscript{73}

Thus, once again the notion of "scientific determination" is supported, i.e. all behaviors have causes; nothing "just happens."\textsuperscript{74}

The literature on factors affecting skill acquisition such as that on retention of motor skills, transfer of learning, task and environmental demands, ability grouping, motivation, and goal setting and aspiration produces mind expanding information, "food for thought," yet leaves researchers and teachers with the responsibility to design instructional systems.

All instruction systems must provide the rudiments of a sound learning environment...If a system (1) provides clear target objectives, (2) deals in some positive fashion with student motivation, (3) provides a strategy for instruction and practice based upon an analysis of objectives, subject matter and a pre-assessment or learner status, (4) measures and evaluates results so that instruction can be adjusted in terms of consequences and (5) does all of this in ways which lead the students to be attracted rather than repelled by the subject matter - the system will work. It will produce learning...\textsuperscript{75}

All researchers find themselves faced with the awesome task of translating facts, beliefs, and speculations into usable curricular activities, materials, and offerings. Thus, this writer turns to the fourth area of review, that of illustrating pertinent research involving


limited time, practice/instruction techniques.

As this study deals with methods of instruction for "first time" students in teaching situations of two hours total duration, it is felt reasonable to review literature describing presentation processes during the initial teaching phase. It is very interesting to note that most methods text books and materials do not deal with teaching beginners as a major topic, rather, the authors generalize whole segments of a particular skill presentation. That is to say the process of teaching, for example golf, is seen as a six to twelve week unit with little information describing each session. Fundamentals or parts of the whole are described, yet very few attempts if any are made at projecting how long, how much or of what quality will performances be after a segment of instruction, over a given period for a particular age group. It would seem, given current scientific advancements, that our profession would have generalized, normative information in a large number of motor skills, yet in most cases, it is sorely lacking. Questions, such as: (a) is being able to make three out of ten foul shots from fifteen feet at a ten foot high hoop a reasonable expectation for a sixth grade boy after a three hour practice and instruction session in shooting the two-handed set shot; (b) how much does previous experience affect his performance; (c) do his overall environmental living conditions affect his abilities to shoot accurately; (d) what arm strength levels are necessary to get the ball to the basket go unanswered. Literally, thousands of unanswered questions remain to be researched before one
can begin to accurately predict student performance after a given length, style, and number of practice sessions and conditions. However, research has given some insight into the process of teaching beginners. It is to these insights that the writer turns his attention.

Investigating learning as a continual process has intrigued researchers for a number of years. Interest in how one begins that process; what kind of steps, phases, sequences, jumps, spurts, plateaus and pinnacles can be expected in any given situation pointed the way for literally an infinite number of investigative studies.

In a 1932 study, Williams suggested that:

The simple motor acts such as throwing a ball or the complex acts in swimming, tennis, golf, dancing, tumbling and other activities require that the pupil get a clear idea of the act to be performed...One learns motor acts by doing them, not by watching someone else or by reading about them...Physical education offers numerous activities in which there are standards to measure success or failure. One jumps the stick or fails to do so. One catches the ball or fails to do so.76

Williams further suggested in a discussion of whole versus part learning that initial instruction should deal with the whole or as large a part as possible, yet felt "...it is better to practice short periods frequently than to concentrate in one long session."77

Of importance two years later was a study by Murphy, 1934, which compared raw score achievement scores on a golf knowledge test.


77 Ibid., pp. 44-45.
Murphy stated that "it is necessary to determine what the difference of twenty three points means in relation to revealing differences between students or groups of students before grading." Murphy underlined the idea that raw score alone does not indicate what progress or how much learning had occurred. Great initial progress by students may be seen in a number of motor acts; yet, later, much smaller increments of progress may be much more significant in terms of distinguishing nearness to the end product or high level achievement.

Keeler, 1938, studying the effects of maturation on physical skill, compared skill advancement with chronological age, mental age, school grade and I.Q. His conclusion indicated that: (1) physical skill growth is most nearly related to chronological maturity; (2) physical skill does not increase with mental age; and, (3) the "very bright" child is likely to stay on the same physical level as the "normal child." 

Brace, 1941, wanted to find out why some individuals learn skills more rapidly than others. Of particular interest was his conclusion that "learning score may be related to the number of practice trials." The old adage that "practice makes perfect" seems still to

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78 Mary Agnes Murphy, "Grading Student Achievement in Golf Knowledge," The Research Quarterly, V, No. 1 (March, 1934), 81-88.

79 Lindsey Keeler, "The Effect of Maturation on Physical Skill as Measured by the Johnson Physical Skill Test," The Research Quarterly, IX, No. 3 (October, 1938), 54-58.

be an indicator of a long term skill development process. Most skills are not easily or immediately mastered.

As interest in pinning down and analyzing the learning process grew, so did suggestions for teaching methodologies. Knapp and Hagman, 1953, offered the following steps for teaching motor skills:

1. Establish concept. The learner must "get the picture", understand what the movement and ideas represent.
2. Provide experiences with the whole. Try it out.
3. Analyze the performance.
4. Provide for practice in parts as needed.
5. Again and continuously, reanalyze performance.
6. Re-establish the whole performance.

In Knapp and Hagman's model the whole-part-whole sequence was assumed to be most effective.

Fitts, 1964, writing on skill learning, broke the continual process of learning into three subphases in order to deal systematically with the totality of learning.

Phase one, designated the early phase involves the simplest of task requiring only the time to understand instructions, complete a few preliminary trials and establish the proper cognitive set for the task;...

Phase two, the intermediate phase suggests a time period in which the learner forms specific associations, learns to respond to specific cues and deals cognitively with the tasks;...

Phase three, suggests a stage where improvement on the task becomes dependent on the conditions of practice available to the learner.

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82 Fitts, op. cit., pp. 261-268.
Significant questions about how people learn were continually being asked again in the late 1960's. Bosworth, 1967, focused upon pre-reading: improvement of visual motor skills. Studying two groups of kindergarten students and testing to determine their ability to copy geometric figures, she was able to develop activities which were intended as enhancers of the ability to copy forms. Bosworth's important first findings concluded that "the ability of kindergarten pupils to reproduce selected geometric figures is amenable to training."\textsuperscript{83}

Thus, accepting Bosworth's findings as having validity, it seems to this writer that it is also possible to design self teaching materials to enhance performance in beginning skills for archery, golf and spinning.

Cratty, 1968, wrote "methods of learning may be placed on a scale - from practice dependent upon precise instructions to practice which is purely trial-and-error."\textsuperscript{84} Cratty further commented on a number of important concepts relating to the instructional process. Some of the more pertinent are as follows:

1. Prior to starting an activity, the performer forms a "set" or attitude towards the task.
2. There are individual differences related to the manner in which various kinds of sensory input are effectively utilized.
3. Formal instruction is best placed during the initial phase of the learning process. Trial and error learning is best engaged in by the learner after he has mastered the task to some degree.
4. Visual demonstration is one of the most effective ways to enhance the learning of a motor skill.

\textsuperscript{83} Cratty, op. cit., pp. 116-124.

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(5) Learning does not usually occur unless there is some way for the performer to obtain knowledge of his relative success or failure. 84

Both Cratty and Singer agree that:

Sex differences in motor performance become more apparent with increasing age. Young boys and girls can compete in similar activities with satisfaction until they approach adolescence... From adolescence to adulthood, boys continually advance in motor performance, girls improve very slightly or even worsen, and the gap in performance between the sexes widens. 85

It is interesting to note that Cratty suggested separation during instruction as a possible avenue to increasing girls performance levels. 86

Generalized statements concerning how to approach beginning instruction, appear in literature as Lawther expounded, from "a synthesis of experimental and empirically derived findings as to what works best for the majority of beginners." 87 Thus, theories of instructional theory, Kirchner, 1970, offered the following guidelines for developing a package of instruction:

1. A theory of instruction should specify the experiences which most effectively implant in the individual a predisposition toward learning - learning in general or a particular type of learning...
2. A theory of instruction should specify the ways in which a body of knowledge should be structured so that it can be most readily grasped by the learner...

84 Cratty, op. cit., pp. 116-124.
86 Cratty, op. cit., p. 46.
87 Lawther, op. cit., p. 65.
(3) A theory of instruction should specify the most effective sequences in which to present the materials to be learned. . . . 

(4) A theory of instruction should specify the nature and placing of rewards and punishment in the process of learning and teaching. 88

Kirchner also felt that motor skill is most effectively learned with distributed practice periods rather than with massed practice periods. "The length of each practice period as well as the length between each practice depends upon the difficulty of the skill, the level of ability, and previous background of the learner." 89

Several sources consistently reveal that motor development proceeds in many differing ways. 90 Hermerdinger and Lewis underscore this variability as they wrote that "motor skill development follows a cephalocaudal (head to lower extremities) sequence. . . ." 91 They suggested that "gross motor skill precedes the fine motor skills and the rate of development of these skills will vary from child to child. . .


89 Ibid., p. 4.


91 Hermerdinger, op. cit: p. 1
dependent upon three factors—heredity, maturation and environment."92 Thus, understanding what to expect from beginning learners becomes an important aspect of designing new means of presenting materials.

The writings of Wickstrom, 1970, revealed that "few longitudinal studies have been done in which the skill development of the same children was followed for a period of several years. . . . There are several possible ways in which individual progress proceeds."93 He continued by listing the following possibilities:

1. A child might skip one or several stages that most other children seem to pass through and achieve a mature pattern at an age as early as 3 or 4 years.
2. A child might linger at an early stage of skill development and then quickly pass through one or more stages without pause.
3. A child might not fit neatly into any typical stage of development but might progress according to the developmental trend for a particular part of the skill pattern.
4. A child might fail to make significant progress in motor pattern development and remain at an immature level or stage indefinitely.94

As self responsibility is one of the prime objectives of school systems, it would appear that learning motor skills offers a unique opportunity to help promote self instruction and learning modalities.95

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92Ibid.
93Wickstrom, op. cit., p. 11
94Ibid.
In a study designed to investigate the development of young children's self responsibility for their school learning, Wang and Stiles, 1976, related that individually prescribed programs are possible through self teaching. "The teacher becomes free to be a consultant plus information generator or translator." The student's function becomes one as follows:

1. Work and complete assigned task.
2. Follow classroom management rules.
3. Budget one's own time to meet the time constraints established for certain tasks.
4. Make decisions about when to do what work.
5. Participate in group activities when required.

The use of printed and static materials has been around for years. Mimeographed materials, graphs, slides, photographs, charts and illustrations have many uses in the instructional process. Yet, Singer and Dick, 1974, reported that "since little research has been done on the benefits of these kinds of media, it is difficult to make any generalizations about them." However, "visualization of a task to be performed has definite ramifications for the development of gross and fine muscle activity." Much research remains to be done to learn how effectively beginners utilize visual materials.

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98 Singer and Dick, op. cit., p. 225.

PROCEDURES

The purpose of this study was to compare three groups of 11-12 year old (sixth grade) children learning "whole" motor skills under controlled, limited time approaches to teaching. This chapter will include methods and procedures undertaken to (a) select subjects and make group assignments, (b) select activities, (c) select the teaching model and the instruction procedures, (d) define the objectives, teaching stations, targets, pre-test, practice, and post-test procedures for the specific skills, and (e) select the statistical treatment techniques.

SUBJECT SELECTION AND GROUP ASSIGNMENTS

In order to achieve a study sample that was largely unskilled in the test items, three sets of 72 (216 total subjects) available sixth grade parochial school students from Stevens Point, Wisconsin, were selected. The subjects came from two closely located elementary schools that do not have physical education programs. The total group was further randomly divided into three major groups of 24 children, each containing 12 boys and 12 girls. Within each major group, three subgroups consisting of (a) eight boys, (b) eight girls, and (c) four boys and four girls (coeducational), received instruction and practice sessions of identical total duration. See Figure 1.
Group 1  
Spin Casting

Group 2  
Archery

Group 3  
Golf

72 Subjects per Skill Group

Group A - Self-Instruction
Group B - Expert Spaced Instruction
Group C = Expert Intensive Instruction

Group A = 24 Subjects
A_1 = 8 Boys
A_2 = 8 Girls
A_3 = 4 Boys + 4 Girls

Group B = 24 Subjects
B_1 = 8 Boys
B_2 = 8 Girls
B_3 = 4 Boys + 4 Girls

Group C = 24 Subjects
C_1 = 8 Boys
C_2 = 8 Girls
C_3 = 4 Boys + 4 Girls

Figure 1
Random Assignment of Groups in Spin Casting, Archery and Golf (Subject Assignment)
The three major groups were then randomly assigned to one of the following sets of conditions: (a) 27 minutes of expert instruction followed by three 24 minute practice sessions spaced over two weeks, each preceded by three minutes of instructional review, (b) 27 minutes of expert instruction followed by 72 minutes of practice which included a three minute instructional review at the end of each 24 minute segment, or (c) 27 minutes of self-instruction followed by three 24 minute practice sessions spaced over a two week period. Each self-instruction group was allowed a three minute access to instructional materials before each 24 minute practice session.

ACTIVITY SELECTION

With the continued growth in opportunity for recreational pursuits outside of the school, it was deemed important to select activities which met the following criteria:

1. Activities which are not currently a common part of the elementary school physical education curriculum, yet, in a wide variety of locations, could be added easily.

2. Activities which offer immediate satisfaction as well as future potential as "lifetime" sports.

3. The activity must be challenging, within mastery range of the subjects, and have an integral reward-feedback system which would be likely to hold and reinforce interest.

4. Subject skill performance must be readily tested and easily recorded in a highly objective manner.
5. End performance must be easily identifiable and measurable when compared to beginning performances.

The activities seeming to meet all criteria were spin casting, golf, and archery.

**SELECTION OF THE TEACHING MODEL, INSTRUCTION PROCEDURES**

To gain consistency in the teaching approach, instructors within the study agreed to teach, using materials which evolved through careful consideration of Lawther's "gross-framework idea" and Stallings' "phases of instruction." Principles basic to the instructional process required tutelage, keeping in mind the following teaching hints:

(a) Acquaint the student well with the equipment and facilities, and introduce the new skills in unified acts large enough to make sense.
(b) Demonstrate; and repeat if he needs further understanding.
(c) Use a design of performance, or form, in executing the activity which has proven successful many times with previous learners.
(d) Allow the individual enough leeway so that he can adjust the form pattern to his peculiar structure and unique function.
(e) Use constructive guidance rather than fault finding in teaching the beginner.

Lawther indicated that:

In epitome, then, the gross-framework idea may be imparted to the learner by (1) demonstrating; (2) manual manipulation (but as a cooperative act); (3) verbal description; (4) movies, loop

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film, stick figures, or drawings; (5) feeling others perform the act combined with manual manipulation (for the blind); or (6) a combination of these methods.\(^4\)

The order of instruction was based on suggestions by Stallings and included the following considerations:

1. Establish a concept of purpose.
2. Structure the environment.
3. Direct attention to key parts of skills.
4. Enhance retention by reviewing what is to be learned.
5. Provide information feedback.\(^5\)

Most groups received instruction based on giving them a "gross-framework idea" of what was to be done by using expert, live demonstrations followed by a secondary line drawing, pictorial sequence allowing questions and answers. Subjects operating under self-instruction did not have the expert available to demonstrate or answer questions. Both line drawings and written explanations were made available for self-instruction. In all cases, fundamental phases of individual skills were stressed.

To insure that specific learning which was task oriented took place, each instructor pursued definite steps in presenting fundamental parts of the whole skill. Subjects being self-taught were told to follow the directions as nearly as possible but to concentrate on improving their score as much as possible on the specified targets.

\(^4\)Ibid. p. 64.

Spin casting, golf and archery were chosen as the skills to be taught. The following section deals with the teaching order, teaching stations, targets, and procedures used in teaching each skill.

**Spin Casting**

Developing initial spin casting skills involved the process of teaching or allowing subjects to teach themselves an overhand method of casting. Subjects were given a 15 minute explanation of (1) the activity they were to attempt to learn, (2) how to care for the equipment and (3) a tour of the casting station.

**Spin casting fundamentals.** Since the purpose of learning to spin cast is to be able to deliver a "bait" or practice plug consistently to a desired spot, the following fundamentals of spin casting were pursued for the overhead cast:

1. Grip - two handed.
2. Stance.
5. Drift/acceleration.
6. Release and follow-through.
7. Retrieval.

Each fundamental or phase of instruction was pictorially depicted with line drawings for all subjects (see appendix). Subjects were
encouraged, within their own limitations, to imitate as nearly as possible the form illustrated in the drawings.

Spin casting pre-test. The subjects were allowed two warm-up casts to test the equipment if they desired. Each subject was then asked to cast, to the target area, ten consecutive times, trying to come as close as possible to the center mark each time. Spotters recorded where each of the casts made initial contact with the target area. The total scores of all 10 trials were recorded. To obtain a baseline indicator of initial skill, a cumulative total of the 10 casts was recorded.

Spin casting equipment. All subjects used standardized equipment consisting of a five foot six inch medium action Zebco #4060 rod (Contennial™), a Zebco model 600 reel loaded with 100 yards of eight pound test "Stren" line, and a 1/4 ounce Weber practice plug. Individuals were assigned to numbered rods and used the same equipment throughout the study.

Spin casting instruction. Basic to the instructional process was the introduction of concepts through the use of live demonstration followed by subject examination of a series of line drawing illustrations. (See Appendix). Each subject was provided with individual study materials in addition to large scale blow-ups of the same materials. These instructional materials followed the sequence suggested in the Zebco booklet.6

---

6 Basic Casting from A to Z: Student's Instruction Booklet (Tulsa, Oklahoma: Zebco, Division of Brunswick Corporation)
Subjects studying under expert assistants were encouraged to ask for assistance when needed. Expert instructors were asked to give technical assistance whenever they deemed necessary during the instructional phase. However, they gave assistance only during the review sessions of the practice phase. Subjects studying in the self-instruction group were not permitted to ask questions of their supervisor or their peers. No live demonstrations were given to this group.

**Spin casting practice procedures.** To standardize the amount of practice, subjects were limited to a maximum of 90 trials for every 24 minutes of practice. A variety of targets, set at 30 feet from the starting line, were arranged for practice. These included hoops, buckets, cans, logs, tennis balls, soccer balls, hula hoops, and cardboard boxes. Students were required to spend one third of their practice time on the test station. See Figure 2. The 90 trials per 24 minute practice session allowed 10 casts at each of the nine stations to complete a practice circuit. Subjects were required to move to a new station every 2 1/2 minutes.

**Spin casting post-test procedures.** The investigator repeated pre-test procedures on the day after completion of the instruction/practice phases of the study. All data were recorded in the same manner as in the pre-test. Any cast landing on a test target pattern line received the next higher score. The cumulative totals of the 10 post-test trials were recorded for comparison purposes.
Figure 2

Diagram of Spin Casting, Pre-Post Test Station

Test Pattern Circle
Diameters

\[ \begin{align*}
10 &= 3' \\
8 &= 4' \\
6 &= 5' \\
4 &= 6' \\
2 &= 7'
\end{align*} \]
Phase two of this study involved teaching the full swing used in the game of golf. With the rapid expansion of golfing facilities, golf is becoming increasingly popular and youth of all ages are seeking instruction in golf skills.

For the purpose of this study, the full swing, using a number nine iron, was selected. Emphasis was placed upon hitting a ball to a target using a full swinging motion. All subject were given 10 minutes of advanced instruction in the use of the overlapping style of gripping the golf club. Subjects were not allowed to swing the club during this instruction. The overlapping style was selected because it is most often recommended by professionals providing "...the best coordination between the hands, allowing them to operate smoothly and efficiently." Subjects were required to use the overlapping grip throughout the study.

Golf fundamentals. In learning a golf swing, one's primary objective is to move the club head through an arc, hitting a ball consistently to a desired target. Consequently, the following areas leading to hitting a golf ball were pursued:

1. Addressing the ball.
2. Comfortable stance.

---

3. Lining up the shot.
4. The swing.
5. Hitting the ball and follow through.⁸

Groups using self instruction techniques taught themselves via cassette loop film instruction produced by the National Golf Foundation.⁹

**Golf pre-test.** On the day preceding the instructional phase of the study, each subject was given the opportunity to hit 12 balls at a designated target. Subjects were advised to get the ball as close to the center circle as they could. Initial contact point with the target was used to determine score. All scores were recorded and totaled to achieve a baseline score. Golf balls were elevated one-half inch from the ground and hit off a golf carpet. Each subject hit 12 consecutive balls at the target. One additional point was added to the score for each time contact was made with the ball. Subjects were allowed a maximum of three minutes to hit the 12 balls and were allowed to hit at their own pace.

**Golf test station** (Wall target, see Figure 3.)

**Golf practice procedures.** All subjects were limited to hitting a

⁸Littler, op. cit., pp. 3-65; see also Golf Lessons, op. cit.; Finsterwald, op. cit., pp. 11-66; Diaz, op. cit., pp. 4-38; and Virginia Linblad Nance and Elwood Craig Davis, Golf (Dubuque, Iowa: Wm. C. Brown Company Publishers, 1966), pp. 8-47.

Circle Diameters

9 = 2'
7 = 4'
5 = 6'
3 = 8'
1 = 10'

Figure 3
Diagram of Golf, Pre-Post Test Station
maximum of 48 golf balls per 24 minutes of practice time (actual count). Basic swing development consisted of hitting the ball 100% of the time toward the test wall target 24 feet from a start line. Each subject was encouraged to work at his own speed during practice, yet to try to hit all 48 of the balls during the 24 minute period. Subjects were encouraged to try to hit the center of a target elevated five feet from the floor.

**Golf post-test.** Pre-test procedures were repeated within 24 hours of completion of the instruction/practice phase of the study. All 12 scores were combined to achieve a post-test level. The cumulative total was recorded for comparison purposes.

**Archery**

Before allowing children to handle potentially dangerous pieces of sporting equipment, the subjects were given 30 minutes of lecture on safety rules and precautions during which all subjects were measured for correct arrow length and given the opportunity to test-pull one of the bows to see that they had the physical strength to draw the bow. Subjects were given a preliminary tour of the archery facilities and were given an explanation of the process of putting up the targets and recording scores.

**Archery fundamentals.** To insure instruction leading to successfully hitting a target, the following sub-parts involved in accurately shooting an arrow were covered:

1. Efficient stance.
2. Nocking the arrow.
3. The draw and anchor.
5. The release.
6. Follow through.\textsuperscript{10}

All materials used for instruction were made available to the group using self instruction techniques. For complete illustration see appendix.

Archery pre-test. On the day preceding the instructional phase of the study, each subject was given the opportunity to shoot three consecutive ends of five arrows each. Total score was kept for all 15 arrows. Any arrow that cut the line between two colors counted the higher score.

Archery equipment. The targets used were from the Saunders Archery Company and were the regulation 60 cm. face.\textsuperscript{11} The target consisted of five concentric rings. The yellow inner circle counted nine points; the red circle counted seven points; the blue circle counted five points; the black circle counted three points; and the white circle counted one point. The bows were from the Herter's Company with the length of 60 inches and the pull weight of 25 pounds. The arrows were also from Herter's with a length of 24 and 26 inches. The shaft was five sixteenth


\textsuperscript{11}Saunders Archery Company, R.R. #1, Box 476, Industrial Site, Columbus, Nebraska, 68601, Target #T31, cm. 60, 36" square.
inch in diameter.\textsuperscript{12}

**Shooting station.** Four shooting stations, separated from one another by four foot by eight foot sheets of plywood, were constructed. Subjects could not watch each other shoot and were safely separated. Subjects were advised to draw the arrow tips to within two inches of the bow before releasing the arrow. An expert observer was stationed directly behind subjects to prevent possible hazardous safety situations. No other advice was given.

**Archery practice procedures.** Using a stop watch to time ends, subjects were allowed approximately 45 seconds to shoot each arrow or three minutes and forty five seconds to shoot five arrows. Subjects could shoot slowly or quickly within the three minutes and forty five seconds. Subjects were limited to a maximum of 36 arrows for each 24 minutes of practice time. The investigator regulated, by signal, the beginning and end of each trial. No formal instruction was given to the first two groups during practice periods, except during the review sessions when students were encouraged to ask questions. The self-instruction group could not ask questions at any time.

**Archery post-test.** On the day after concluding the instruction/practice phase of the study, the investigator tested the entire group using the same procedures as in the pre-test. Again, subjects shot three consecutive ends of five arrows each. The total score for all 15 arrows was recorded for comparison to the pre-test scores.

\textsuperscript{12}Herter's Inc., R.F.D. #2, Interstate 90 Mitchell, South Dakota, 57301, Bow model #QA2K3, Farbenglas (A German fiberglass), arrows model #QB1E1 and QB1E2.
In each of the three sub-studies, baseline scores were compared to end results by determining mean scores for each set of conditions. See Table 1 below.

Difference scores for each subject were determined by subtracting pre-test totals from post-test totals. Evaluation of the effectiveness of each set of conditions was computed by comparing mean scores of each group.

### Table 1

<table>
<thead>
<tr>
<th>Sample Statistical Comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spin Casting</td>
</tr>
<tr>
<td>Expert spaced</td>
</tr>
<tr>
<td>Expert intensive</td>
</tr>
<tr>
<td>Self instruction spaced</td>
</tr>
</tbody>
</table>

A repeat design using a 3 x 3 analysis of variance (Anova) was used to determine significant differences between groups and were reported as "F" ratios. Orthogonal polynomial comparisons were made when significant differences within groups occurred. Grand Means ($\bar{x}$) scores were examined to further explore within group trends. The .05 level of significance was accepted as proof of significant differences.
The following hypotheses were tested:

1. \( H_0 : \mu_A > \mu_B > \mu_C \)

The performance of groups receiving expert instruction and spaced practice will be greater than the performances of the groups receiving expert instruction and massed practice which will then be greater than self instruction and spaced practice.

2. \( H_0 : \mu_A = \mu_B = \mu_C \)

There will be no significant differences between group performances.

3. \( H_0 : \mu_C > \mu_B \) or \( \mu_A \)

Self instruction will significantly increase performance levels when compared to the other two sets of conditions.

4. \( H_0 : \mu_\Phi > \mu_\Phi < \mu_\sigma \)

Co-educational groups will exhibit higher levels of performance than girls yet will not be higher than those composed of all boys.

5. \( H_0 : \mu_\sigma > \mu_\Phi \)

Boys in all skills will perform at significantly higher levels than girls.
ANALYSIS OF DATA

The intent of this study was to investigate the effects of three styles of subject matter presentation as used to maximally assist sixth grade boys and girls learn sport skill fundamentals. As such, the primary focus was on identifying productive methods of teaching introductory lessons in spin casting, archery and golf using sessions of no more than two hours total duration. Secondarily, it was sought to make an analysis of the differences within performances between sets of all boys, all girls and co-educational groupings. Each sport activity was treated as a separate sub-study, even though the statistical design and treatments remained constant throughout. A total of five hypotheses were tested within this investigation.

For purposes of clarity, results are reported in the following order: (1) spin casting, (2) archery, (3) golf.

Findings which required further statistical analysis follow the findings of significance.

INTRODUCTORY SPIN CASTING METHODOLOGY RESULTS

Between group differences in spin casting methodology was determined by comparing each of the three styles of teaching through analysis of variance. Table 2 contains the mean difference scores of each of the three tested groups.
Table 2
Mean Scores for Expert Spaced Instruction, Expert Intensive Instruction and Self Instruction in Spin Casting

<table>
<thead>
<tr>
<th>Group</th>
<th>Learning Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(24)</td>
</tr>
<tr>
<td>Expert Spaced Instruction</td>
<td>26.25</td>
</tr>
<tr>
<td>Expert Intensive Instruction</td>
<td>26.25</td>
</tr>
<tr>
<td>Self Instruction</td>
<td>26.83</td>
</tr>
</tbody>
</table>

It appears that method of instruction did not effect performance in spin casting. Table 3 reflects the mean scores of groups divided by sex and suggests that being grouped co-educationally is not detrimental to overall performance in spin casting.
Table 3
Mean Scores for Performance Levels of Boys, Girls, and Co-educational Groups in Spin Casting

<table>
<thead>
<tr>
<th>Group</th>
<th>Learning Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(N=24)</td>
</tr>
<tr>
<td>All Boys</td>
<td>29.42</td>
</tr>
<tr>
<td>All Girls</td>
<td></td>
</tr>
<tr>
<td>Co-ed 4 Boys - 4 Girls</td>
<td></td>
</tr>
</tbody>
</table>

The results of the 3 x 3 analysis of variance are contained in Table 4. Analysis found a minutely small nonsignificant difference F-value of 0.0078 for the main effects in performance in the Expert Spaced Instruction, Intensive Instruction or the Self Instruction groups. This rejects hypothesis number one which states that children receiving Expert Spaced Instruction would surpass in performance those children receiving Expert Intensive Instruction who in turn would surpass those receiving Self Instruction. Further, sex of the child did not seem to have an effect on the performance levels. The small F-values of 0.0078 (Method) and 0.6035 (Sex Comparison) seems to indicate that the skill of spin casting is well within the conceptual capabilities of the subjects in the study.
Table 4
Analysis of Variance Results for Spin Casting on the Three Learning Methods

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>D.F.</th>
<th>Sums of Squares</th>
<th>Mean Squares</th>
<th>F-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex Comparison (A)</td>
<td>2</td>
<td>420.11</td>
<td>210.06</td>
<td>0.60</td>
</tr>
<tr>
<td>Method Comparison (B)</td>
<td>2</td>
<td>5.44</td>
<td>2.72</td>
<td>0.06</td>
</tr>
<tr>
<td>A x B</td>
<td>4</td>
<td>1488.22</td>
<td>372.06</td>
<td>1.07</td>
</tr>
<tr>
<td>Error</td>
<td>63</td>
<td>21928.00</td>
<td>348.06</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>23841.78</td>
<td>335.80</td>
<td></td>
</tr>
</tbody>
</table>

F(0.05, 2, 63) ≈ 3.15   F(0.05, 4, 63) ≈ 2.53

Evaluation of individual block differences was not deemed necessary because of the insignificant interaction F ratio's. This suggests that neither sex mixture nor methodological approach significantly changed performance within the design. Because interaction was statistically insignificant, it may be very important in terms of methodological selection on behalf of teachers who are choosing a presentation style for introductory spin casting lessons.

INTRODUCTORY ARCHERY METHODOLOGY RESULTS

This section (section 2) presents results of the analysis of variance in the archery sub-study. An examination of the data reveals
contrasting information. Table 5 reflects the mean score distribution of methodological differences in archery.

Table 5

<table>
<thead>
<tr>
<th>Group</th>
<th>Learning Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(24)</td>
</tr>
<tr>
<td>Expert Spaced Instruction</td>
<td>23.21</td>
</tr>
<tr>
<td>Expert Intensive Instruction</td>
<td>17.54</td>
</tr>
<tr>
<td>Self Instruction</td>
<td>14.92</td>
</tr>
</tbody>
</table>

A closer examination of deviations from the grand mean suggests that there may be a difference in the amount of learning which took place between groups who were grouped according to method of teaching approach.

Figure 4 reflects grand mean differences to such a degree that it was deemed necessary to further analyze the data to see if actual differences occurred.

Further orthogonal comparisons were conducted and are reported in Table 6.
Mean Scores

E.S. = Expert Spaced = 23.21  
E.I. = Expert Intensive = 17.54  
S.I. = Self Instruction = 14.92  
G.M. = Grand Mean = 18.56

Scale Adjusted to Zero

Figure 4

Grand Mean Deviations for Expert Spaced, Expert Intensive, and Self Instruction Groups in Archery
Table 6

<table>
<thead>
<tr>
<th>Instructional Method</th>
<th>Y,j</th>
<th>C₁ Intensive vs. Expert</th>
<th>C₂ Self vs. Intensive + Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Instruction</td>
<td>358</td>
<td>0</td>
<td>-2</td>
</tr>
<tr>
<td>Expert Intensive Instruction</td>
<td>421</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>Expert Spaced Instruction</td>
<td>557</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

\[ S.S. = \frac{(\text{difference})^2}{N(\sum C_j^2)} \]

- \( C₁ = 385.3 \)  \( F \text{ value for } C₁ = 2.63 \text{ N.S.} \)
- \( C₂ = 376.7 \)  \( F \text{ value for } C₂ = 3.50 \text{ N.S.} \)

\[ F.05,1,69 \approx 4.00 \]  \( F \text{ values are not significant.} \)

Hypothesis number three states that self instruction will significantly increase performance when compared to the other two sets of conditions. Table 6 rejects this forecast in that an F value of 3.5 confirms that there is no significant difference between Self Instruction and Expert Intensive + Expert Spaced Instruction in Archery.

Closer examination of the grand mean deviations (Figure 4) indicates a more linear relationship as predicted in hypothesis number one. However, while there are differences between methods, neither of the contrasts examined distinguish themselves. An F value of 2.63 indicates no significant differences between Expert Spaced Instruction and Expert Intensive Instruction. In addition an F value of 3.5 suggests no significant difference between Self Instruction and Expert Spaced Instruction + Expert Intensive Instruction.

Table 7 contains a summary of the groups by sex in Archery.

Table 7

<table>
<thead>
<tr>
<th>Mean Scores for Groups Related by Sex; All Boys All Girls, Co-ed 4 Boys - 4 Girls, in Archery</th>
<th>Learning Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Boys</td>
<td>26.71</td>
</tr>
<tr>
<td>All Girls</td>
<td>14.92</td>
</tr>
<tr>
<td>Co-ed 4 Boys - 4 Girls</td>
<td>14.04</td>
</tr>
</tbody>
</table>
Initial inspection indicates that boys being grouped only with other boys will perform at higher levels than both girls and co-educational groups. Hypothesis 4 states that co-educational groups will exhibit higher levels of performance than girls but not higher than those groups composed of all boys. Closer inspection of grand mean deviations and orthogonal comparisons of sex mixtures reveal insufficient data to support hypothesis number four.

Figure 5 represents grand mean comparisons based upon sex mixture while Table 8 reflects actual differences found through orthogonal comparison.
Mean Scores

A.B. = All Boys = 26.71
A.G. = All Girls = 14.92
C.E. = Co-Ed. = 14.04
G.M. = Grand Mean = 18.56

Scale Adjusted to Zero

Figure 5

Grand Mean Deviations for Sex Mixtures: All Boys, All Girls, Co-Educational - 4 Boys - 4 Girls in Archery
Table 8
Orthogonal Comparison
of Sex Mixtures
in Archery

<table>
<thead>
<tr>
<th>Sex Grouping</th>
<th>Y.j</th>
<th>C1 All Boys vs. Co-ed</th>
<th>C2 All Boys Co-ed vs. All Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Boys</td>
<td>641</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>All Girls</td>
<td>358</td>
<td>0</td>
<td>-2</td>
</tr>
<tr>
<td>Co-ed</td>
<td>337</td>
<td>-1</td>
<td>1</td>
</tr>
</tbody>
</table>

\[
\text{S.S.} = \frac{(\text{difference})^2}{N(\leq C_{ij}^2)}
\]

\[
C_1 = 1925.3 \quad \text{F value for } C_1 = 14.1^{**}
\]

\[
C_2 = 467.7 \quad \text{F value for } C_2 = 3.5
\]

\[
F(.05,1,69) \approx 4.00 \quad F(.01,1,69) \approx 7.08
\]

Analysis of data suggest that males in this study performed better when segregated but more interesting is the fact that boys in co-educational groups performed at a much lower rate on the average than boys who were segregated. On the surface it appears that boys should be separated for archery lessons. However, several factors such as a more male orientation or acceptance of archery as an appropriate skill to be learned or the possibility that boys' scores were lowered

\[\text{Ibid.}\]
in co-educational Intensive Instruction groups due to the influence of girls presence could have lowered co-educational performance. Therefore, while an F value of 14.1 in comparisons of all boys vs. co-ed groups is statistically significant, it seems to this investigator to not be sufficiently conclusive evidence to suggest single sex groupings for boys.

Table 9 contains a complete summary of findings in the archery sub-study.

Co-Lateral Findings in Archery. Observations revealed a number of pertinent findings. Although not emphasized in this study, they are of sufficient importance to be listed as follows:

1. Most subjects studying under intensive practice procedures exhibited a considerable amount of fatigue during the teaching session. Although all completed the required number of practice trials, several complained of developing blisters and shoulder girdle and arm soreness.

2. In one girls' group, 7 out of 8 self-taught girls positioned the arrow on the incorrect side of the arrow rest to shoot post-test scores. While they were able to successfully hit the target they apparently overlooked the technical aspect of nocking an arrow. This was a frequently noticed problem in all self-taught groups.

3. An F ratio of 3.17 indicated that there was a significant difference within the styles of teaching archery, yet planned orthogonal comparisons resulted in findings of non-significance. Using further analysis it was determined that the
Table 9
Archery: Analysis of Variance.
Complete Summary of Results

<table>
<thead>
<tr>
<th>Summary Table</th>
<th>dF</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex Mixture</td>
<td>2</td>
<td>2402.03</td>
<td>1201.01</td>
<td>8.83*</td>
</tr>
<tr>
<td>All Boys vs. Co-ed</td>
<td>1</td>
<td>1925.33</td>
<td>1925.33</td>
<td>14.16**</td>
</tr>
<tr>
<td>All Boys + Co-ed vs. All Girls</td>
<td>1</td>
<td>476.69</td>
<td>476.69</td>
<td>3.51 N.S.</td>
</tr>
<tr>
<td>Teaching Method</td>
<td>2</td>
<td>862.03</td>
<td>431.01</td>
<td>3.17*</td>
</tr>
<tr>
<td>Expert Intensive vs. Expert Spaced</td>
<td>1</td>
<td>385.33</td>
<td>385.33</td>
<td>2.83 N.S.</td>
</tr>
<tr>
<td>Self vs. Expert Intensive + Expert Spaced</td>
<td>1</td>
<td>476.69</td>
<td>476.69</td>
<td>3.51 N.S.</td>
</tr>
<tr>
<td>Sex Mixture x Teaching Method</td>
<td>4</td>
<td>927.22</td>
<td>231.81</td>
<td>1.70 N.S.</td>
</tr>
<tr>
<td>Error</td>
<td>63</td>
<td>8566.50</td>
<td>135.98</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>12757.78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F (.05,2,63) ≈ 3.15  F(.05,1,69) ≈ 4.00
differences laid between the Self Instruction method and the Expert Spaced method of teaching archery. An F ratio of 6.13 indicates very strongly that Expert Spaced instruction was the most productive means of instruction when comparing Self Instruction to Expert Spaced Instruction. A non-significant F Ratio of 0.27 was found when comparing Self + Expert Instruction to Expert Intensive instruction. These findings suggest that beginners were able to more functionally use expert advice than self advice and that initial learning in archery is enhanced with Expert Spaced instruction. Thus the researcher suggests that curriculum planners make use of experts for teaching beginning archery skills whenever possible.

INTRODUCTORY GOLF METHODOLOGY RESULTS

It has been said that the art of hitting a golf ball accurately with consistancy is one of the most difficult tasks one can undertake. Thus this sub-study sought to test methods of improving the success ratio's of beginning golfers as they attempted to use a full swing and hit a golf ball. Table 10 contains the results of the mean difference scores for Expert Spaced Instruction, Expert Intensive Instruction and Self Instruction. Hypothesis number one states that Expert Spaced Instruction followed by Expert Intensive Instruction and then Self Instruction would be the order of performance to be expected. However, just the opposite occurred in this study, thus hypothesis number one cannot be supported.
Table 10

Mean Scores in Golf Performance for Expert Spaced Instruction, Expert Intensive Instruction and Self Instruction

<table>
<thead>
<tr>
<th>Group</th>
<th>Learning Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(24)</td>
</tr>
<tr>
<td>Expert Spaced Instruction</td>
<td>7.71</td>
</tr>
<tr>
<td>Expert Intensive Instruction</td>
<td>13.46</td>
</tr>
<tr>
<td>Self Instruction</td>
<td>19.13</td>
</tr>
</tbody>
</table>

Hypothesis number three predicted that self instruction would be the most productive method when compared to the other two sets of conditions. Grand Mean (Figure 6) examination suggests that it is likely to be superior. Orthogonal comparisons were done to verify differences.
Mean Scores

E.S. = Expert Spaced Instruction = 7.71
E.I. = Expert Intensive Instruction = 13.46
S.I. = Self Instruction = 19.13

G.M. = Grand Mean = 13.43

Scale Adjusted to Zero

Figure 6

Grand Mean Deviations for Expert Spaced, Expert Intensive and Self Instruction in Golf
Table 1 supports hypothesis number three and indicates that children in this study found expert advice to be detrimental to their performances.

Table 11


<table>
<thead>
<tr>
<th>Instructional Method</th>
<th>$Y_{ij}$</th>
<th>$C_1$ Expert Intensive vs. Expert Spaced</th>
<th>$C_2$ Self Instruction vs. Expert Intensive + Spaced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Instruction</td>
<td>459</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Expert Intensive</td>
<td>323</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>Expert Spaced</td>
<td>185</td>
<td>-1</td>
<td>-1</td>
</tr>
</tbody>
</table>

$$S.S. = \frac{(\text{Difference})^2}{N\left(\frac{1}{2} C_j^2\right)}$$

$C_1 = 396.75 \quad \text{F value for } C_1 = 2.30 \text{ N.S.}$

$C_2 = 1167.36 \quad \text{F value for } C_2 = 6.77^*$

$*F(.05,1,69) \approx 4.00 \quad F(.01,1,69) \approx 7.08$

An F value of 6.78 with .05+ level of significance suggest very strongly that the materials used to enhance idea formation were then put into action, and resulted in improved performance in golf.

3Ibid.
These results indicate that the sixth grade children in the study found usable information in the loop films used for demonstration purposes. Practice procedures were alike for all groups, thus practice alone cannot be the performance distinguishing factor.

Table 12 features characteristics noted by comparing groups according to sex mixtures. It is very interesting to note that a very small non-significant $F$ value of 0.64 indicates that being separated by sex does not improve performance at this initial level in golf. All boy, all girl and co-ed groups found golf to be of a very nearly identical degree of difficulty. This finding further lends strength to hypothesis number three which stated that self instruction would be more productive than the other sets of conditions.

Table 12
Mean Scores in Golf for Groups According to Sex Mixture: All Boys, All Girls, Co-ed - 4 Boys - 4 Girls

<table>
<thead>
<tr>
<th>Sex Mixture</th>
<th>Learning Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I(24)</td>
</tr>
<tr>
<td>All Boys</td>
<td>15.83</td>
</tr>
<tr>
<td>All Girls</td>
<td></td>
</tr>
<tr>
<td>Co-ed - 4 Boys - 4 Girls</td>
<td></td>
</tr>
</tbody>
</table>

A non-significant $F$ value of 0.64 indicated that further comparison was unwarranted. Table 13 summarized all findings in the golf study.
Table 13

Summary of Results of Expert Spaced Instruction, Expert Intensive Instruction, Self Instruction, Group Sex Mixtures and Orthogonal Comparisons in Golf.
(Analysis of Variance)

<table>
<thead>
<tr>
<th>Summary Table</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex Mixture</td>
<td>2 220.86</td>
<td>110.43</td>
<td>0.64 N.S.</td>
</tr>
<tr>
<td>Teaching Method</td>
<td>2 1564.11</td>
<td>782.06</td>
<td>4.54*</td>
</tr>
<tr>
<td>Expert Intensive vs.</td>
<td>1 396.75</td>
<td>396.75</td>
<td>2.30 N.S.</td>
</tr>
<tr>
<td>Expert Spaced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self Instruction vs.</td>
<td>1 1167.36</td>
<td>1167.36</td>
<td>6.78*</td>
</tr>
<tr>
<td>Intensive + Expert Spaced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex Mixture x Teaching Method</td>
<td>4 1654.31</td>
<td>413.58</td>
<td>2.41 N.S.</td>
</tr>
<tr>
<td>Error</td>
<td>63 10852.37</td>
<td>172.26</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71 14291.65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ F(.05,2,63) \approx 3.15 \]
\[ F(.05,1,69) \approx 4.00 \]
SUMMARY AND CONCLUSIONS

Developing introductory techniques which produce high ratios of success during initial attempts to learn sports skills remains a constant challenge to teachers of young people. Thus the purpose of this investigation was to compare three selected groups of 11-12 year old children learning "whole" motor skills under controlled, limited time approaches to teaching. Particular emphasis was placed upon identifying productive methods of teaching children spin casting, archery and golf skills, during the initial learning phase, in sessions of less than two hours total duration.

The investigation included three sets of 72 (216 total subjects) sixth grade children from two parochial schools in Stevens Point, Wisconsin. The subjects were selected in order to achieve a sample study that was very likely unskilled in the test items. They were from two closely located elementary schools that did not have physical education programs. As pre-determined by random assignment, the total group (each group of 72) was further randomly divided into three major groups of 24 children each containing 12 boys and 12 girls. Within each major group, three sub-groups were constructed consisting of (a) eight boys, (b) eight girls, and (c) four boys and four girls (co-educational).

The three major groups in each sub-study were to receive instruction and practice sessions of identical total duration. Thus,
subjects were randomly assigned to one of the following sets of conditions: (a) 27 minutes of expert instruction followed by three 24 minute practice sessions spaced equally over two weeks, each preceded by three minutes of instructional review, (b) 27 minutes of expert instruction followed immediately by 72 minutes of practice which included a three minute instructional review at the beginning of each 24 minute segment, and (c) 27 minutes of self instruction group was allowed a three minute access to instructional materials before each 24 minute practice session.

All calculations were made using mean difference scores from pre-post test data. Groups were compared to analyze instructional method and sex mixture characteristics. Both instructional method and sex mixture were evaluated using a treatment by sex mixture (3 x 3) analysis of variance design. Subsequent analyses were performed by orthogonal comparison of pre-selected group combinations.

The trend analysis of the three sub-studies resulted in significant differences in the following manner: (See Table 14.)
<table>
<thead>
<tr>
<th>Sub-Studies</th>
<th>Sex Mixtures Significance</th>
<th>Instruction Method Significance</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spin Casting</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>0.60</td>
<td>0.01</td>
<td>1.07</td>
</tr>
<tr>
<td>Archery</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>8.83*</td>
<td>3.17*</td>
<td>1.70</td>
</tr>
<tr>
<td>Golf</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>0.64</td>
<td>4.54*</td>
<td>2.40</td>
</tr>
</tbody>
</table>

\[ F(.05,2,63) \approx 3.15 \]

The analysis of variance in spin casting suggests that neither sex mixture nor instructional method made a significant difference. Thus the findings indicate that one does not have to be an expert to assist in the learning of initial skill in spin casting. It appears that very productive self-instruction methods and materials are currently available for use by the general public. In addition, it seems that the overhand cast in spin casting is an easily learned recreational skill that can be acquired at a young age. It further seems likely that short, intense, courses for young students can be easily offered without the fear of fatigue factors limiting performance or decreasing interest. Examination of the data revealed that all groups acquired skill at approximately the same rate. The overhand cast in spin casting appeared to be quickly conceptualized by both male and female
subjects while the challenge of learning to cast was enjoyed by both.

Archery results offered varied characteristics. Analysis of variance and orthogonal comparison revealed significant differences in sex mixture groups with boys performing much higher than girls. Boys performances were inhibited when boys were grouped with girls while girls achievement increased slightly when grouped with boys as compared to all girl groups. Further research needs to be done to explain the evident differences between boy and girl performances particularly when they are grouped co-educationally. Within the limits of this study, it appears that boys should be separated until such time as research can determine educational groups in archery.

In addition, examination of methods of archery instruction showed significant statistical differences and appeared to show performances in the predicted linear order of expectance with Expert Spaced Instruction being most productive followed by Expert Intensive Instruction and then Self Instruction. Although caution is urged as performance differences are suspect and may have been caused by unknown variables not accounted for in the study, expert advice was found to be an important aspect of learning to shoot an arrow. It appears that the stop action, controllable, aspects of shooting an arrow allowed subjects to analyse and change their performances using expert advice. The researcher recommends using Expert Spaced Instruction to alleviate the problems of fatigue and muscle soreness which occurred during intensive instruction.

Golf results revealed opposite methodological results from the predicted ones, with Self Instruction proving most productive followed
by Expert Intensive and then Expert Spaced Instruction. Expert Instruction appeared to be detrimental to performance within the limits of the study. In that golf is a highly complex skill requiring much fine motor control, it appears that getting used to swinging the club by oneself is more important than receiving instruction from an expert on how to swing the club. Self Instruction results suggest very strongly that allowing children to concentrate on hitting the ball without worrying about details of form may be the most productive approach to teaching initial learners. Over analysis appeared to be detrimental to initial performance.

It further appears very possible to design self-instruction hitting stations where children can experience productive practice sessions as they learn to hit a golf ball using a full swing.

Sex mixture seemed to have no effect on the performances of children. This supports the investigators contention that sport skill, task difficulty, needs to be analyzed very carefully when making curriculum activity selections. Both boys and girls found golf to be a highly difficult skill to master.

CONCLUSIONS AND RECOMMENDATIONS

Within the limitations described in the body of this investigation, the following conclusions and recommendations appear to be warranted.
Spin Casting.

During the initial stages (first two hours of instruction) methodological approach made no significant difference in performance. Children acquired the skill of spin casting, performing very similarly in Expert Spaced Instruction, Expert Intensive Instruction and Self Instruction modes of learning.

Arranging the instructional groups by varying the sex mixture did not significantly alter the performance. All boys, all girls and co-educational groupings showed no significant differences in final performance.

The implications for application to methods of instruction appear very interesting in light of the review of literature which suggested that expert teaching and spaced practice would be the most productive approach for beginners. Based upon the results of this investigation it suggests that teachers have much latitude and should be encouraged to use a variety of teaching approaches to introduce spin casting skills. Spin casting is well within the learning capacities of sixth grade children. It is easily conceptualized and accepted by both boys and girls as an appropriate skill to be learned.

Further, it seems that self-instruction materials are in existence and should be made available for use by public schools, private agencies and the general public as an attractive, viable alternative method of learning initial skills in spin casting. This should be of particular interest to groups interested in promoting fishing skills as a life-time activity.
The equipment used in the study was found to be easily assembled and cared for and is recommended as being of good quality for sixth grade children.

In addition, with the onset of mandatory co-educational classes in many school systems, the reported results support the concept of co-ed classes during introductory lessons in spin casting. It also points to excellent possibilities for further individualization of instruction for potential learners. This is a much needed development in physical education in our schools, particularly at the elementary school level where our school concentrates on producing self-directed learners.

The conclusions suggest several implications for further research. As many previous studies in the learning of sports skills span several weeks or months, it appears imperative that further study needs to be done to project long range effects of initial introductory method. Various combinations of spaced and massed instruction could be compared to find the most beneficial strategy to be used to acquire high level efficiency in casting skill.

As this study made use of large scale blow-up (life-size) pictures, in addition to individual sized materials with word descriptions, it seems beneficial to further refine the materials to find out the effects of various terminology usage for young children. In addition, determination should be made as to the effects of life-size line drawing models on the concept formation process of young children. Do children need life-size models and are life-size models beneficial to "get the idea" of what is to be done, needs further investigation.
Archery.

Methodological F-value indicated a significant difference between Expert Spaced, Expert Intensive and Self Instruction in archery. Further analysis on the contrast examined (Expert Spaced vs. Expert Intensive and Self Instruction vs. Expert Spaced + Expert Intensive) revealed no significant differences. However caution is urged on accepting the findings as indicating that differences within methodology do not exist. In fact, further analyses indicated that Expert Spaced instruction was the most acceptable and productive form of instruction for curricular purposes.

Analysis of sex mixtures suggests that the boys in the study performed at higher levels when segregated and at lower levels in co-educational groupings. However, again caution is urged as unaccounted for variables may have influenced the boys scores. This calls for additional research findings.

This study was concerned by design with only those methodological contrasts suggested. As a significant F-value is indicated within methods of teaching, it is logical to suggest that further investigations focus upon the differences between Expert Spaced Instruction and Self Instruction. Further, the materials used to teach arrow rest positioning need to be further refined to produce more consistent arrow positioning. As fatigue began to be evident at approximately the one hour and thirty minute point in Expert Intensive Instruction it seems worthwhile to repeat similar comparisons to see if a shorter time span would have produced significant differences in learning.
Additional investigation on the effects of boy or girl presence within co-education archery lessons is suggested as needed to help explain the very evident loss of male performance when grouped with girls.

**Golf.**

Based upon the results of this study, it appears that Expert Instruction at the initial stage of learning a highly complex skill such as golf may have a detrimental effect on immediate performance. Paralysis by over analysis may have affected their performance. This is not to say that Expert Instruction is not beneficial over longer periods of time. It does indicate a need for further investigation to determine trend continuation. Self Instruction appears to be a more effective means of presentation within the limits of this design.

Altering sex mixture did not make a significant difference in group performance and reinforces this investigator's belief that task performance is highly related to previous experience and task difficulty.

The investigator's observation of "swing patterns" as individually being very poorly developed in the study population, leads to suggesting further research in developing the young child's concept of swinging motions. This supports the need to offer programs of physical education in the elementary schools which offer great variety and offer much experimentation opportunities.
General Conclusions.

Throughout this study the investigator has become more convinced that the process of learning sports skills depends upon discovering the keys to learning whether they be hierarchial in nature or in some other format. Continuous attempts must be made to dove-tail "pure" motor research with "action" research using subjects in actual teaching situations. Criteria needs to be developed so that at any given stage in the process of learning skill, educators can make logical, and appropriate selection of future learning materials. General developmental levels need to be established for all of the activity "tools" in the physical educators repertoire. Physical educators and researchers have been lax in this area and still cannot, with confidence, predict general performance levels in a variety of popular sports skills.

Further, much research needs to be undertaken to discover the maximum effective size of small groups. It appeared that groups of eight children were easily taught in all situations within this study yet very little is currently known about the performances of smaller or larger groups. Methodological investigation needs renewed emphasis.
APPENDICES
Making Your Play

A. The overhead cast

a. The two-handed cast results in greater accuracy, even for experienced spin-cast fishermen. Using the "rod hand", hold your rod with its reel handles pointing up, your thumb depressing the thumb stop. Now place your "line hand" just ahead of the reel as shown and take the line lightly between your thumb and index finger. Got it? Try this. Depress the thumb stop and let the weight of your plug take the line out. Feel it slip through your thumb and finger? Do it again, and this time use that same thumb and finger to slow the line down a bit. Now one more time — only this time stop the line completely: at 12 inches; at the halfway mark; just as the plug touches the floor. The rest is easy and you've only just begun.

b. Assume a casual, sure-footed stance before the target, your body angled so that your "pitching arm" takes the lead. Now lift the rod until its tip is just above the target (10 o'clock). Note that your elbow and upper arm should be close to, but not against the body; that the forearm parallels the angle of the rod.

Figure 7

Step 1, Spin Casting Self Instruction Guide

Basic Casting from A to Z: Student's Instruction Booklet. Tulsa, Oklahoma: Zebco, Division of Brunswick Corporation.
c. To start the cast, lift your arm with a smooth, accelerating motion of the wrist that puts your hands at eye-level. Stop the rod at approximately 1 o'clock, allowing the momentum of the lure to flex the rod tip backward.

d. Without hesitation, commence the forward stroke with a quickly accelerated motion of the wrist and forearm. Follow exactly the same path as you took on the upstroke. At about 11 o'clock, release the thumb stop to set the lure in flight.

Figure 8
Step 2, Spin Casting Self Instruction Guide

---

2Ibid.
e. Follow through by lowering the tip of the rod to follow the flight of the lure. Note: if the lure goes straight up into the air, you released the line too soon; if it takes a nose-dive at your feet, you let go too late.

f. As the lure nears the target, begin to apply pressure to the line with the thumb and index finger of your line hand. This braking, or "feathering" action allows pinpoint accuracy by bringing the lure to a slow, gentle stop. More precise than relying on the thumb stop, it also prevents the line from back-looping inside your reel.

Figure 9

Step 3, Spin Casting Self Instruction Guide

\(^3\text{Ibid.}\)
g. Retrieval is simply a matter of turning the crank handle. There's no need even to switch the rod to the other hand, for your "other" hand has been there from the beginning. Let the line flow through the thumb and index finger of this hand on its way back to the reel. It's a trick that serves to maintain tension on the pickup mechanism and to clean the line for another trouble-free cast.

Figure 10

Step 4, Spin Casting Self Instruction Guide

4Ibid.
Standing

Position
Stand at a right angle (90 degrees) to the target. Spread your feet to give yourself firm, comfortable stance. Balance is important. Stand straight. Place your toes as if they were on an imaginary line drawn straight to the center of the target.

STEP NO. 1
YOUR STANCE

Figure 11
Step 1, Archery Self Instruction
Nocking

To nock an arrow means to place the arrow on the bow string at the nocking point. If you are a right-handed shooter, you should hold the bow in the left hand, parallel to the ground and about waist high. The string is towards the body.

Place the arrow shaft on the arrow rest in the center of the bow. Place the nock on the string at the nocking point. The arrow rest will be on the left side of the bow.

Always nock the arrow in the same spot on the bowstring. This spot should be where the arrow and the bowstring meet at a 90 degree angle. To hold the arrow at this spot on the string, place a permanent nocking point made with a metal clip or thread on the string just above the nock.

The cock feather should be up at right angles to the string. It is usually a different color and will be on the left when the bow is raised.

STEP NO. 2
NOCKING AN ARROW

Figure 12
Step 2, Archery Self Instruction
How to Draw the Bow

**Low Position**

**High Position**

**STEP NO. 3**

**DRAWING AND HOLDING**

**Drawing**

Hold the bow with a relaxed grip, but firmly enough to keep the bow from falling when shot. Do not grip the bow tightly. Right-handed archers will hold the bow in their left hand. When drawing, the bow is held so the grip is just below eye level with the bow arm held straight out. Stand up straight, and extend arm as if pointing at the target.

After the bow is raised, the string is brought back with the first three fingers of the draw hand. The arrow nock is held lightly between the first two fingers. The string should be drawn by the tips of the first three fingers. Hold the bow with a straight arm. Draw the bow until the index finger of the draw hand is firmly anchored at the right corner of the mouth for the right-handed shooter. This is called the anchor point. Keep the draw arm elbow up and forearm parallel to the ground. The same anchor point should be used for every shot.

**Holding**

Although raising the bow and drawing to the anchor point is done in one continuous motion, the arrow is not immediately released. Aim is taken and a deliberate pause assures the shooter that everything is right. Most experienced archers take aim and hold at full draw for several seconds before releasing.

Figure 13

Step 3, Archery Self Instruction
Instinctive Aiming Method

Fix both eyes on target.
Line up with arrow point.

Releasing

Releasing is accomplished by relaxing the string fingers which allows the string to roll off smoothly. This can be done easily and consistently if the back muscles are used to draw and hold the string. When drawing, try to touch your shoulder blades together. This puts back muscles to work. When the string slips from the fingers, the hand should be relaxed. Trying to let go of the string causes the draw hand to end up out and away from the face. This should be avoided.

Follow Through

Simply stated, follow through means maintaining the full draw position until the arrow strikes the target. The bow arm should be held straight out and not dropped until the arrow reaches its destination. Follow through in bowling can mean the difference between a strike and a gutter ball. The same holds true for shooting a bow. Holding the position assures good form and the likelihood of a better target hit.
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