ABSTRACT

Novak, Michael, F. The effect of massed versus distributed practice on free throw shooting accuracy. M. S. in Physical Education, 1980. 56 p. (Dr. Burt McDonald).

Fifth and sixth grade boys (N = 38) participated in the free throw study to examine the effects of massed and distributed practice during a 10-session experimental program. Ss were randomly assigned to two groups: a massed practice group (n = 19), and a distributed practice group (n = 19). Each S in the massed practice group practiced 20 consecutive free throws during each session. Each S in the distributed practice group practiced 20 free throws, attempted two free throws then waited until every other subject in his sub-group had attempted two free throws before taking his next turn. An ANCOVA produced $P > .05$ between the massed practice free throw shooting method and the distributed practice free throw shooting method. Results of using the adjusted mean scores indicated that the massed practice group showed the greater increase in improvement over the distributed practice group.

CHAPTER III

METHODS

Introduction

This chapter has been divided into the following areas: (1) subject selection; (2) procedures; and, (3) statistical treatment of data.

Subject Selection

Subjects for this study were a total of 38 fifth and sixth grade boys from Emerson Elementary School in La Crosse, Wisconsin. The subjects ranged in age from ten to thirteen years and were selected on the basis of not being influenced by previous basketball coaching methods. The subjects were randomly divided into two groups through the use of a table of random numbers for forty subjects. One group was known as the massed practice group and the other was known as the distributed practice group. The subjects were not informed of the purpose of the study.

Procedure

The testing period for this study was scheduled for ten practices for each of the two groups beginning during the first week of May, 1979, and extended through the fourth week in May, 1979. Both groups practiced the same day, but met only three times per week (Monday, Wednesday, and Friday).

Each of the two practice groups were tested separately during the testing period. For convenience, and because the testing was performed on only two of the baskets at Emerson Elementary School's gymnasium, each of the two practice groups were divided into three sub-groups. Each sub-group was assigned one of the two baskets at which they practiced at during the entire testing period. Each sub-group was also assigned a scorer to record the scores of each subject.

Following a pilot study (Appendix A) conducted with fifth grade boys, it was determined that fifth grade boys did not have the proper amount of strength to shoot a free throw using a regulation basketball, at regulation distance (15 feet), and at a regulation basketball goal (10 feet height). These standards were used to make a comparison with the second pilot study which used different standards and fourth grade boys rather than fifth grade boys because it was believed that accomplishments at the fourth grade level would be seen at the fifth grade level with some improvements in skill and ability.

A pilot study was then conducted using fourth grade boys at a nine foot basket with an intermediate basketball from fifteen and ten feet in distance. The pilot study made use of the suggestions by Dauer (1965, p. 263) "that baskets should be lowered to nine feet instead of the regulation height of ten feet....for an elementary school program,": Miller (1971), that an intermediate or junior basketball will give an accurate indication of learning that takes place involving fifth grade boys; and, Archer (1966), that the distance of the foul line be reduced from fifteen to ten feet for youngsters. As a result of this second pilot study (Appendix B), it was determined that fifth and sixth grade boys would provide an accurate indication of the learning that was to take place in a study of massed versus distributed practice utilizing a nine foot basket with an intermediate basketball from a foul line that is a distance of ten feet from the basket.

Testing procedure for the massed practice group consisted of twenty free throw attempts. Each subject attempted the twenty free throws in succession during one turn at the free throw line.

The testing procedure for the distributed practice group consisted of twenty free throw attempts. Each subject attempted two free throws and then waited until every other subject in his sub-group had attempted two free throws before taking his next turn.

Each subject received three warm up free throws before their twenty free throw attempts as suggested by McCraw (1955). The testing procedure for each practice group was consistent in each of the ten sessions of the testing period.

A chart was prepared daily for each subject's results of the free throws attempted during the practice session (Appendix C). This was done so each subject would have a knowledge of results, which is necessary for improvement in motor skills (Bell, 1970).

The pre-test, which was the first practice session, and the post-test, which was the tenth practice session, was administered in the same manner and order as all of the other practice sessions.

Statistical Treatment of Data

The analysis of covariance was used to determine if there is a significant difference between the massed practice group and distributed practice group. Level of significance was set at .05.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

This study dealt with the problem of determining whether massed free throw shooting practice or distributed free throw shooting practice was the more effective method of free throw shooting. Data was collected from the pre-test and post-test on two groups, one group utilizing the massed free throw shooting method and the other utilizing the distributed free throw shooting method.

The pre-test was administered during the first of ten practice sessions. The post-test was administered during the tenth and final practice session.

Subjects

Twenty-eight of the subjects used in this study were fifth grade boys and twelve were sixth grade boys. Each group had 20 subjects randomly assigned to it. Two subjects were unable to complete the study, one from each practice group. One subject was absent due to travel with his family, the other was absent for the post-test due to illness. Therefore, statistical analysis for each practice group was based on n = 19. The total number of subjects completing the study was 38.

Results

An analysis of covariance was computed in order to determine whether there is a significant difference between massed and distributed free throw shooting practice on free throw shooting accuracy. The pre-test was used as the covariate and the post-test was used as the dependent variable.

Table 1 indicates the means, mean gains, standard deviations, and the mean adjusted of pre-test and post-test free throw shooting scores.

Table 1

Means, Mean Gains, Standard Deviations, and Mean Adjusted of Pre- and Post-Test Free Throw Shooting Scores

	Mean	Mean Gain	Standard Deviation	Mean Adjusted
Massed				
Pre-Test	8.7895		2.9304	
Post-Test	9.0000	+.2105	4.2426	8.4800
Distributed				
Pre-Test	7.4210		3.1841	
Post-Test	7.9474	+.5264	3.7483	8.4674

It should be noted that using mean gains, both massed and distributed groups improved over the ten practice periods. The distributed practice group showed the greatest improvement with a gain of .5264. The massed practice group showed the least improvement with a gain of

.2105. However, when the post-test adjusted means were used, the massed practice group actually performed better than the distributed practice group.

Table 2 shows the results of the analysis of covariance of pre- and post-test scores of the free throw shooting. This table reveals an F value of 8.47266E-05. At the .05 level of confidence, an F value of 4.11 was needed for significance.

Table 2

Analysis of Covariance of Pre- and Post-Test Free Throw Shooting Scores

	Between	Within	Total
DF	1	36	37
SUM SQRS X	17.7896	355.79	373.579
SUM XY	13.6846	270.421	284.105
SUM SQRS Y	10.5264	608.947	619.474
ADJ SS Y	9.76562E-04	403.412	403.413
ADJ DF	1	35	36
MEAN SQR	9.76562E-04	11.526	11.2059
F	8.47266E-05		

Based on the analysis of covariance, the null hypothesis was accepted. Massed practice of free throws and distributed practice of free throws are equally effective in free throw shooting accuracy.

Discussion

For learning to occur during the testing period of both massed and distributed practice groups, each individual participating in the study had to be exposed to many kinds of stimuli. The stimuli, such as distance to the basket, sound of the ball bouncing, and the feel of the ball, was received by the subjects through their sense receptors which include the eyes, ears, nose, mouth, and skin. At the point of receiving the stimuli, it was converted to an electrical signal and sent to the higher levels of the nervous system or the brain. The electrical signals or the data, at this stage was put in order and then went into one of the memory stores where it was either stored for a long term or a brief amount of time and then used. Once the data was translated, it went in electrical signal form to motor neurons or effectors for output. The effectors controlled the voluntary muscles of the body, some of which include the hands and feet (Welford, 1976). At this point the action of the free throw shot was carried out by the subject. For learning to occur the brain must have been responsible for reception, perception, thought, and action (Singer, 1968).

In the early stages of learning a motor skill such as the free throw shot, each action is a conscious act. The action must be overlearned before it moves to the subconscious level and be performed automatically (Sage, 1977).

Individual differences are seen primarily because the skill is never performed the same way, even in the same person, although the successful result can be achieved in several ways. A number of factors affect what is learned by a subject while shooting the free throw shot. One of these is knowledge of results, which will inform the subject as to whether the free throw shot was made or missed. This factor reinforces the correctly performed free throw shot (Singer, 1975). Knowledge of results works together with feedback, which is a response to the output (Drowatsky, 1975). The feedback that the free throw shooter must be attentive for, is whether he believes the physical actions just performed were done correctly and whether the basketball went through the basket.

If the learning of the free throw shot is to occur, the free throw shooter must have an incentive or desire to want to learn to shoot properly. This incentive or desire is motivation. Without motivation, learning will not occur and execution of the free throw shot will suffer.

Other motor tasks also have an affect on the learning of the free throw shot. Similar tasks such as volleyball may have a positive affect on the free throw shot because of the relationship to the volleyball set. This would be a positive transfer. Whereas horseshoe pitching may have a negative transfer because of the underhand motion.

Exercise to the point of fatigue may limit the performance of the free throw shot, but the learning of the free throw shot can occur during this time. Since "learning is not affected by fatigue," the free throw shot can be taught under both situations, the rested condition and the fatigued condition (Schmidt, 1972, p. 240).

Although the physical practice of the free throw shot cannot be performed at all times, mental practice can aid those times when physical practice is impossible. Mental practice is the mental rehearsal of the motor skill. The rehearsal is accomplished by imagery (Bell, 1970).

Both massed and distributed practice can profit the learning of free throw shooting accuracy. The distributed practice method of free throw shooting uses short interspersed periods of rest during practice. During these rest periods mental practice may take place. Distributed practice may be helpful in free throw shooting accuracy for immediate performance (Singer, 1975). The massed practice method of free throw shooting may be preferred for learning if the subjects are highly motivated and top performance is needed (Sage, 1977). The massing of practice can also reach higher levels of learning sooner than distributed practice (Lawther, 1977).

The results of this study showed that there was improvement in both the massed and distributed practice groups, although the improvements in either group had no statistical significance. When observing the difference in the mean scores of the pre- and post-test, the distributed practice group had slightly more improvement than that of the massed practice group. Once the means were adjusted by using the statistical treatment, the massed practice group showed the increase in improvement over the distributed practice group. A number of motor learning researchers (Cratty, 1973; Drowatzky, 1975; Singer, 1975) agreed that distributed practice is more effective than massed practice in learning motor skills. This study indicated that the difference in what is commonly believed by some researchers and what the adjusted means showed, may have been due to some of the individual differences by those in the distributed practice group, or possibly due to the motivational level of those subjects in the distributed practice group. Both massed practice groups and the distributed practice groups had their practice sessions at the same time and in the same gymnasium. Each practice group had the opportunity to see how the other group performed their practice free throws. Since the massed practice group normally completed their free throw shooting before the distributed group because of the method used, the subjects in the distributed practice group had a tendency to become frustrated by the method they used. Therefore, they may have been less motivated to learn free throw shooting accuracy simply because of the free throw method used.

The results of this study indicate little difference in the performance of massed free throw shooting practice to distributed free throw shooting practice on free throw shooting accuracy. Additional research using more highly controlled conditions is needed to substantiate these observations.

CHAPTER V

CONCLUSIONS

Summary

The problem of this study was to determine whether massed free throw shooting practice or distributed free throw shooting practice was the more effective method of free throw shooting practice for fifth and sixth grade boys with ages from ten to thirteen years. The 38 fifth and sixth grade boys chosen for this study were from Emerson Elementary School at La Crosse, Wisconsin.

The testing period involved ten practices on Mondays, Wednesdays, and Fridays over a four week period. The 38 subjects were randomly divided into two groups, one the massed practice free throw group and the other the distributed practice free throw group. Each of these groups was further divided into three sub-groups. Each group was assigned a basket in the Emerson Elementary gymnasium. A nine foot basket, a ten foot free throw line, and an intermediate basketball were used by each practice group.

Each subject in the massed practice group attempted twenty free throws in succession during one turn at the free throw line for each practice session. Each subject in the distributed practice group attempted a total of twenty free throws, two free throws in a turn, then waited until every other subject in his sub-group attempted two free throws before taking his next turn for each practice session.

A pre-test was administered at the first practice session and a post-test was administered at the tenth and final practice session. The testing procedure for each practice group was consistent in each of the ten sessions of the testing period.

An analysis of covariance was employed to the pre-test and post-test data to determine if any significant differences existed between the two practice groups at the .05 level of confidence. The results of the study produced an F value of 8.47266E-05 at the .05 level of confidence. An F value of 4.11 was needed for significance. Based on these results the null hypothesis was accepted.

Conclusion

Based upon the analysis of the data collected, which did not produce significant differences between groups, the hypothesis for this study, which was stated in the null form, was accepted. Massed practice of free throws and distributed practice of free throws are equally effective in free throw shooting accuracy.

The results of the post-test showed that there was improvement in both the massed practice group and the distributed practice group. The post-test adjusted means showed the massed practice group with more improvement than that of the distributed practice group. The results received in the study were contradictory to the results that researchers (Cratty, 1973; Singer, 1975) would commonly expect. It was concluded that this result was due to test conditions in the study and the individual differences of the subjects in each of the groups.

Recommendations

The following are recommendations for continued and improved study in the area:

1. Research using more highly controlled conditions where groups are unaware of the other method being used in testing.

2. A study be designed in which different age groups, junior high school age, high school age, and college age, are used as subjects.

3. A study utilizing both boys and girls at different age groups should be considered to determine if one method would be more effective for a certain sex at a certain age.

4. The study be designed using girls only, at different age levels, to compare the different free throw practice methods at the different age levels.

5. A similar study could be conducted in which the number of practice sessions was increased to allow a higher level of learning to occur.

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APPENDIX A

Pilot Study to Determine Whether Fifth and Sixth Grade Boys Have the Proper Amount of Strength to Shoot a Free Throw Using a Regulation Basketball, at Regulation Distance, and at a Regulation Basketball Goal

St. Peter & Paul Elementary, Green Bay, Wisconsin

5th Grade April 12, 1979

Subject	Age	Total Made Out of Ten FT	Comment
1	11	1	Pushing
2	11	3	Good
3	10	0	Pushing
4	11	0	Pushing
5	11	2	Pushing
6	11	7	Pushing
7	11	2	Good
8	11	4	Good
9	11	4	Good
10	11	2	Pushing
11	11	0	Pushing
12	10	7	Good
13	10	0	Pushing
14	10	5	Good
15	10	4	Pushing
16	12	1	Pushing

Results - 26%

APPENDIX B

Pilot Study to Determine Whether Fifth and Sixth Grade Boys Would Provide an Accurate Indication of the Learning That Takes Place Using a Nine Foot Basket, Intermediate Basketball, and Ten Foot Free Throw Line

Emerson Elementary, La Crosse, Wisconsin

4th Grade April 26, 1979

Subject	Age	Total From 15' of 5 FT	Total From 10' of 5 FT
1	10	3	4
2	9	0	2
3	9	0	1
4	10	0	4
5	10	0	0
6	9	0	2
7	10	2	2
8	10	0	2
9	10	2	1
10	9	0	0
11	9	0	2
12	10	1	1
13	10	1	1
14	11	0	3
15	10	2	3
Results –		15%	37%

APPENDIX C

RAW DATA

Massed Practice Group

Subject	1	2	3	4	5	6	7	8	9	10
1	10	8	10	8	4	2	7	9	8	16
2	12	16	15	8	14	13	8	13	15	16
3	8	5	5	11	7	5	4	8	4	10
4	10	6	5	9	–	6	12	5	6	9
5	13	12	6	8	8	6	9	7	5	6
6	5	6	7	6	–	8	–	4	5	4
7	13	11	17	14	18	13	10	16	10	14
8	5	3	7	4	5	3	9	2	4	2
9	9	6	7	12	9	7	6	6	9	5
10	11	14	7	6	5	14	7	12	6	11
11	10	12	10	14	10	16	14	4	8	12
12	11	15	13	15	9	10	6	14	9	16
13	–	–	–	–	–	–	–	–	–	–
14	3	3	6	11	7	4	7	6	4	5
15	9	8	7	–	–	6	10	4	5	8
16	7	8	12	11	6	3	7	5	8	9
17	4	10	6	12	7	7	7	6	5	5
18	10	9	5	4	4	5	3	3	7	5
19	6	2	6	8	4	8	3	4	8	7
20	11	10	11	13	7	7	10	8	9	11

continued

Distributed Practice Group

Subject	1	2	3	4	5	6	7	8	9	10
1	8	7	9	2	-	4	-	4	11	-
2	8	8	7	6	-	6	9	6	-	9
3	14	11	16	10	7	7	12	11	9	11
4	4	9	15	10	9	4	11	11	6	8
5	6	13	6	5	7	5	5	10	11	6
6	7	5	11	12	13	6	12	7	12	12
7	3	7	5	6	-	9	12	3	-	6
8	9	6	8	11	7	6	12	10	-	11
9	5	6	9	12	8	6	5	4	5	9
10	2	-	3	-	3	2	4	4	4	4
11	6	3	4	5	6	3	7	7	7	7
12	12	13	9	7	9	11	11	9	9	-
13	12	12	11	9	9	9	12	19	15	14
14	6	10	12	9	12	8	12	12	8	10
15	5	2	4	3	-	3	4	7	3	4
16	10	5	-	9	5	7	5	7	4	4
17	10	13	13	10	8	12	14	16	13	17
18	7	6	1	5	3	6	8	-	8	5
19	6	5	10	7	-	12	5	8	3	4
20	13	8	7	9	13	10	14	13	8	10

The Effect of Massed Versus Distributed Practice on Free Throw Shooting Accuracy

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A Thesis Presented

to

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by

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We recommend acceptance of this thesis in partial fulfillment of this candidate's requirement for the degree:

Master of Science in Physical Education

The candidate has completed his oral report.

Thesis Committee Chairperson	May 2, 1980 Date
Thesis Committee Member	May 7, 1980 Date
Thesis Committee Member	Date

This thesis is approved for the School of Health, Physical Education and Recreation.

Dean, School of Health, Physical Education and Recreation	4-28-80 Date

DEDICATION

I dedicate this thesis to the memory of my grandmother, Anna Koehler, who I love so much. She has given me the encouragement, prayers, and love to continue to become the best I can become.

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CHAPTER I

INTRODUCTION

Background

In the last minutes of a closely fought basketball game a player shoots a free throw. The ball arches perfectly and swishes through the basket for one point. The basketball player has taken into account the events that happen outside of his body; knowledge of the distance of the basket has come to him through his vision; he has heard the sounds of the crowd; he feels the size, shape, and texture of the ball. The knowledge of the internal world is also available to him.

> Joint receptors make known the position of his body parts. Muscle spindles and golgi tendon organs signal impressions of the state of contraction of muscles. The decision to shoot, the sensory information, and the kinesthetic memory of the learned movement are integrated within the nervous system. The results of this integration causes the muscular contraction necessary for the movement which in turn results in the perfect shot (Bell, 1970, p. 3).

It has been stated by Bell (1970) that there are generally two phases in learning a motor skill. As a learner attempts a new movement he consciously plans many of its parts; he also perceives many sensory cues. The initial movements are awkward and full of tension. In the second phase of learning the motor act becomes automatic. This will happen through practice and repetition. During this second phase, tension decreases and the neural direction of movement takes place at subconscious levels of function. Because a motor act is the result of integration of sensory input and repetition of the act, the physical educator and the coach must be concerned with the types of sensory input which will enhance learning as well as the types of practice conditions which are most effective in repetition of movement.

Statement of the Problem

This study dealt with the problem of determining whether massed free throw shooting practice or distributed free throw shooting is the more effective method of free throw shooting practice. The study tested fifth and sixth grade boys with ages ranging from ten to thirteen years.

Need for the Study

The method of how competence in a motor skill is ascertained is in question. There are a number of items we need to know more about to explain the continuing improvement in motor skills. These items include the behavior necessary for improvement to take place, the physiological changes that must occur, and the role of practice to attain this competence.

The increasing emphasis on experimental method and the psychology of learning:

> Reflect the growth of psychology from mainly a speculative and descriptive discipline to one that now, on the basis of evidence, seeks the cause of behavior. By using experimental

> methods in the search for the conditions that cause behavior, we attain the knowledge we need to control and direct behavior. A purely speculative psychology cannot with much precision and success, tell the physical educator how to arrange for classroom and practice situations that promote the change in behavior he seeks to effect (Paterson and Hallberg, 1965, p. 211).

How the nervous system produces a coordinated motor pattern such as the graceful performance of the skillful athlete or the ordinary movements of daily life has long been one of the major mysteries. For any movement to be effective an appropriate group of muscles must be selected, each muscle fiber must be activated in the proper sequence to the others and a precise amount of inhabition must be sent to each of the muscle fibers of the muscle groups which oppose the intended movement. The central nervous system, besides producing the contraction of a certain group of muscles, must control the effects of its commands and coordinate the movements of segments of the body. It must then complete a given phase in a movement pattern and proceed to the next phase (Sage, 1977).

Learning anything new must involve changes among the many billion of neurons in the brain.

> What we must do to understand how learning occurs is to examine the mechanism that is most involved in behavior - the nervous system. It is a fundamental fact that the changes in behavior called learning are in the last analysis a result of changes in the nervous system (Sage, 1977, p. 164).

Besides learning being viewed as a neural change, learning also occurs as a result of experiences with stimuli in the environment. The entire set of conditions responsible for learning is partly external to the individual (Lawther, 1977).

Singer (1975, p. 364) stated that "practice is a necessary prerequisite for learning skills". Merely observing and thinking about a motor skill will not work in the acquiring of a high level of skill. Skillful responses are developed only through repetition of the desired movement pattern and improvement occurs only if conscientious attempts to improve are made (Sage, 1977).

> Since practice does play such a prominent role in the learning of motor skills, it is essential that those charged with teaching these skills have a thorough understanding of the role played by the practice situation during practice (Paterson and Hallberg, 1965, p. 240). Skills are built up by practice allowing the learner to form associations between stimuli and responses, and practice is more effective when undertaken in an organized fashion, the utilization of conditions with specified goals and guidelines seems logical for enhancing skill developement (Holding, 1973, p. 100).

These situations can be developed by clearly determining the elements of the skill, by acquiring the principles necessary for its mastery, by describing how it is and what it is we want the subject to learn about the skill, and then test to determine if the elements used prove to be valuable and beneficial in learning the skill.

It is necessary to understand what happens inside the mind and the body of individuals as they begin the learning process of a motor skill. The conscious and subconscious plans of the learner's mind and the contracting muscles and position of joints must be of concern to those who wish to enhance learning. Knowledge of the different variables that can positively or negatively effect the learning process need to be acknowledged. Variables such as fatigue and stress may have negative effects on an individual during the learning process, while knowledge of results and transfer may have a positive effect. It is also necessary to find which variables would be present in a certian method which is to be utilized in the learning process and compared to other methods to find which is more effective in learning.

This study attempted to find which method of free throw shooting practice had the greatest effect on free throw shooting accuracy. It tested the massed free throw shooting method against the distributed free throw shooting method.

Hypothesis

The hypothesis, stated in the null form, has been formulated to read:

Massed practice of free throws and distributed practice of free throws are equally effective in free throw shooting accuracy.

Assumptions

This study had one assumption:

(1) Each subject performed the best he could for each test.

Delimitations

This study had three points of delimitation:

(1) The subjects in this study were limited to fifth and sixth grade boys.

(2) Data was obtained from subjects who were present for the pre-test, post-test, and eight or more of the ten practice periods (Miller, 1971).

(3) No attempt was made to assess motivation, general motor ability, motor educability, intellectual capacity, or cultural background.

Limitations

There are two limitations of this study:

(1) No control of subjects outside of the testing time was maintained while participating in the study.

(2) All free throws performed by the subjects were performed the same way each time.

Definition of Terms

(1) Massed Practice - "little or no rest between the beginning and the completion of practice on the activity" (Oxendine, 1968, p. 206).

(2) Distributed Practice - rest intervals between a set of a few trials (Sage, 1977).

Note: In some definitions used in other studies (Refer to Chapter II), massed practice is used to refer to trials completely uninterrupted by rest, or in terms of the number of minutes per day, or number of days per week. In some studies, distributed practice refers to trials interrupted by seconds, in others by days, and in others by weeks.

(3) Motor Learning - a relatively permanent change in behavior as a result of experiences at some activity or task (Schmidt, 1975).

(4) Motor Skill - "a task which includes the necessity on the part of the performer to move accurately and with strength and/or power in various combinations" (Cratty, 1973, p. 5).

(5) Pushing - used in comments in Appendix A, refers to fifth and sixth grade subject's ability to shoot a basketball in defined conditions. Subject forces the free throw shot to the basket using a style different to that which is commonly considered a good free throw shooting style.

(6) Good - used in comments in Appendix A, refers to fifth and sixth grade subjects ability to shoot a basketball in defined conditions. Subject shoots the free throw shot to the basket using the style commonly considered good free throw shooting style.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

This chapter is divided into the following areas: 1) Motor Learning; 2) Basketball Coaches and Researchers Views of Massed vs. Distributed Practice of the Basketball Free Throw; 3) Related Studies; 4) Use of Fifth and Sixth Grade Boys in Testing Procedure; 5) Use of the Ten Foot Free Throw Line in Testing Procedure; 6) Use of the Nine Foot Basket and Intermediate Basketball in Testing Procedure; and 7) Use of the Warm-up in Testing Procedure.

Motor Learning

One of the first and most influential schools of thought affecting research on behavior is behaviorism. From behaviorism came stimulus-response (S-R) psychology which contributed a great deal to the understanding of how learning occurs. Formal measurements were taken on subjects in controlled situations by psychologists studying behavior. The research and theory were highly mechanistic compared with humanistic approaches that were used to study behavior. The learning generalizations from this research were made from group collected data. Some believed that certain responses would occur from particular events in a situation, and all people would be affected in the same manner. This response is shown in Figure 1.

Specific _______________ Organism _______________ Situation
Situation Specific Response

Figure 1. Response from a Specific Situation (Singer, 1975, p. 3)

Other scholars responded to this simplistic view of human behavior. They placed emphasis on cognition and perception as well as on attitude and feeling, and found that there were great differences in the way people respond, behave, and learn. It is then essential that we incorporate the generalities of what we know about human behavior with the individual differences (Singer, 1975).

Oxendine (1968, p. 15) has sighted four elements that are necessary if learning is to take place:

> 1) A living motivated organism. All living organisms can learn, although some reach greater and different kinds of learning than others do. 2) An incentive which will lead to satisfaction of motives. Incentives are central to learning. 3) A barrier or block which prevents the organism from immediately gaining the incentive. 4) Effort or activity on the part of the organism to attain the incentive.

Initial responses may or may not prove successful. The attainment of the incentive often involves the realization of a means-to-end connection on the part of the learner. The speed of learning then depends upon the capacity of the individual, the degree of motivation and the nature of the task.

The nervous system permits the activity of receiving and transmitting a stimulus. This system is build of independent units called neurons, which are responsible for the input and output of information.

Sense receptors convert information input into electrical signals which are transmitted through the spinal cord and brought to the higher levels of the nervous system (Singer, 1968).

Welford (1976) divided the sense receptors into two groups:

> One group consists of receptors which receive data from external sources - eyes, ears, nose, mouth, and skin. The other group is divided into two categories. First there are the external receptors in muscles, tendons, and joints which supply data which seldom impinge on consciousness, but play an important role in the control of movement. Second, there are some less understood sensors which measure the state of the blood chemistry, of dehydration, and of other bodily conditions, and which seem to act directly on the brain (p. 3).

Once the data goes through the various senses it then goes through the perceptual mechanism. The data is put in order and supplied with data from the long-term memory store until ready to form the basis of action. Immediately or after a short delay in the short-term memory store, data is put into the translator mechanism, which programs a sequence of muscular action to execute a response (Welford, 1976). The data in the long-term memory store, according to Welford (1976), is held there in some enduring form, which may be either "biochemical or a submicroscopic structural change in brain cells" (p. 7). The short-term store holds limited amounts of data for short periods of time, after which it is completely forgotten.

Motor neurons are responsible for output. They transmit impulses through nerve fibers to terminals in skeletal muscles and these follow the orders of the nervous system. Welford (1976) divided the motor neurons or effectors into two groups. One includes the hands, feet, vocal cords, and other voluntary muscles. The other group consists of various reactors of the autonomic system, which usually do not come under voluntary control.

When learning centers are activated, the learning of a motor skill requires the interaction of the areas of the brain responsible for sense reception, perception, thought, and action (Singer, 1968). Whiting (1975) provided the major sub-systems in terms of physical components:

Sense Organs------Central Mechanism------Muscular System

Figure 2. Physical Components of the Major Sub-Systems (Whiting, 1975, p.8)

At the functional level the major sub-systems of physical components are responsible for input to the system, decision making and output.

> The three major divisions of the central mechanism deal respectively with perception, translating perception to action, and the control of action (Welford, 1976, p.3).

Robb (1972) suggested "that a skilled act is learned through a hierarchical organization" (p. 42). In this organization a plan or "executive program" is developed to "control the order in which a sequence of operations is performed" (Robb, 1972, p. 43). Subroutines are units which make up the parts of the executive program. Each subroutine is a unit of movement that must be overlearned, and once this occurs the subroutines move to a lower level in the hierarchy.

In a skilled act, an individual first has an executive program in which the goal and objective, which give direction to the movement, is recognized. Then decisions and adaptations are made to order the execution of certain subroutines (Sage, 1977). The subroutines being just one part of the total movement must be overlearned so that they can be performed automatically. Once they are overlearned, they are put into a sequence where they must work in relation to one another. The skilled act then requires the executive program to order the subroutines in a sequential and coordinated manner. When a skill is repeated, it is never performed identically. The same executive program can be achieved in several ways. It is the skilled individual who has cut down the number of ways to do the skill and the number of errors.

The process of learning a skill in this manner is divided into three phases. In the first phase, the learner must formulate an executive program where he learns the sequential order of the skill. The receptors are utilized to take in as much information about the skill as possible. The second phase involves practice, so the learner can fix the sequence into normal activity. The amount of practice that is necessary depends on the individual. Finally, in the third phase, the learner is able to perform the total executive program with little conscious effort. In this phase, the skill moves to a lower level in the hierarchy and makes room for other parts of the skill (Schurr, 1975).

When considering the learner, not taking into account the practice conditions and setting, it becomes apparent that a number of factors emerge that might affect the learning of most tasks. Robb (1972) stated that:

> Educators have long been aware of the existence of the individual variance . . . only recently have they begun to understand something about some of the human factors that may cause the normal range of variation (p.16).

When a specific task is being learned, individual differences can be seen in a group even when the skill level of the individuals is relatively equal. The explanation for this occurance is that the learning rate and learning capabilities vary for each individual. As individuals practice, learning factors effect each person differently, which affects the speed and amount of learning (Sage, 1977).

One of these factors is the knowledge of results (KR). "Knowledge of results is a form of reinforcement, the individual is informed as to the correctness or incorrectness of his responses" (Singer, 1975, p. 429). Knowledge of results is associated more with external sources of information that the learner can use on his next attempt at the skill. Knowledge of results is typically received when we perform most athletic skills, such as making a basket in basketball, making a putt in golf, or striking a ball in fair territory in baseball. The knowledge that the performer has on variations which have been found to be more effective because of past performance, seems to be basic to learning. Little or no learning takes place without knowledge of results of the performance. It follows then that progressive improvement accompanies KR, and deterioration occurs after knowledge of results is removed (Drowatzky, 1975).

The teacher's role with KR is to provide ways for the learner to recognize and use cues that will be used in the skill. This can be accomplished by modifying or supplementing information which is fed back to the learner thereby determining his actions (Holding, 1973).

Feedback is a factor that works together with KR. It can be described as:

> A return of part of the output, or response to the input, which may lead to either a revision of the response just made, or to a confirmation of the response as being correct (Drowatzky, p. 85).

A tree diagramed by Holding (1973) explained many varieties of feedback involved in motor performance and learning. The top of this tree found intrinsic and artificial feedback.

> Intrinsic feedback is naturally present in a task, while artificial feedback has been added by the teacher or experimenter. It is a type of extra information such as encouragement. If the feedback is movement producted, it is reactive, but if it deals with effects of movement on the environment it is operational. Dynamic feedback relates to changing aftereffects, while static feedback is nonchanging aftereffects of a movement. Concurrent feedback is present during the entire time the performer is responding, and terminal feedback is produced after the response occurs. Verbal feedback is in the form of words or scores, while

nonverbal feedback is in the form of physical actions. Finally, feedback may be given as a separate piece of knowledge after each response or accumulated over several responses and given at the end of the attempts (Drowatzky, 1975, p. 89).

In Figure 3, the left side represents performance feedback, and the right side is feedback used during learning.

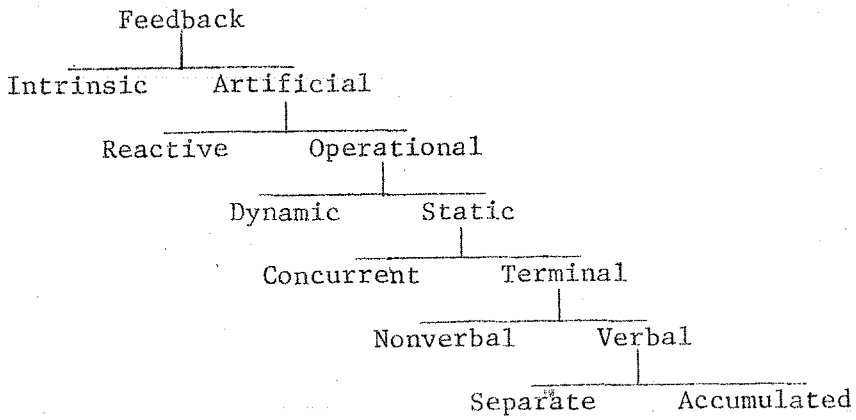

Figure 3. Varieties of Feedback Involved in Motor Performance (Holding, 1973, p. 22)

The most obvious and important effect of feedback is that of correction of errors. Beginning performers appear to benefit from feedback that directs them toward the correct pattern (Welford, 1976). It also has a motivational effect producing satisfaction to continue the skill.

The ability to perform a skilled task is strongly affected by practice and by the amount of motivation of the individual. Lawther (1977) defined motivation as "the state of being aroused into action, which may result from some internal organic or psychic need" (p. 170).

Motivation is categorized into two groups. Intrinsic, which is motivation from personal reasons; such as joy, satisfaction, or skill development; and extrinsic motivation is motivation for material gain (Singer, 1968).

Motivation is an important prerequisite for both learning and performance. If a person is not motivated to learn, then learning will not take place and performance will suffer, which will affect both immediate performance and the permanent learning process (Robb, 1972). Competition is used by teachers to improve motivation. It can be used in two ways, first against the performance of others, and second against one's own standards. Success in competition normally leads to the raising of the motivational level. In competition, evidence has been found by Singer (1975, p. 412), that indicated that "more difficult tasks require lower motivation, because high motivation impedes the acquisition of skills." This result may take place because the inner drive or impulse that causes one to act may cause one to over react when faced with the more difficult tasks, and exaggeration will occur. The teacher's role in motivation then, is to understand how people are motivated and to apply techniques that the learner can use to understand his own motivation.

The learning of one task affects the learning of the next. The more similar the two tasks, the more interaction there will be between them. This interaction is referred to as transfer. Positive transfer means that the performance of the first skill will improve the second skill. Negative transfer means the first skill will cause the second skill to be performed more poorly than if the first had not been engaged in (Cratty, 1973). As Singer (1975) indicated, positive transfer probably occurs more easily in youthful years than in the later, more advanced years, although all adult learning depends on the transfer of habits that have been previously learned, and most learning situations have some characteristics in common.

Information about the levels of learning in the initial practice of a skill and a period of no practice with retesting information, is very important to teachers in their planning of programs and practice. Teachers often seek the levels which can be expected after no practice and which factors will produce high performance following the no practice period (Bell, 1970). Retention is the term that refers to this level of performance following periods of no practice. This measures the amount of remembering. Retention is known to be highest when a skill is overlearned.

There are mixed opinions on which practice method will yield the greatest amounts of retention. Oxendine (1968) stated that the skill learned over a long period of time (distributed) will retain the highest level, whereas Singer (1975) contended that a greater massing of trials will yield the greatest level. In either case, Cratty (1968) concurred that if the individual is informed prior to the learning process that the skill is to be retested at a later date, retention is likely to be greater.

The nervous system is the primary limiting factor for all kinds of work, and fatigue can affect this system. Sage (1977) stated that there are great amounts of data which indicate that exhaustive exercise tends to depress the neural mechanisms that are related with attentive behavior. This impairment of some of the brain mechanisms must be reversible in the sense that it disappears with rest. Singer (1975) stated that although there is an assumption on the part of many that fatigue disrupts learning and performance, this may not always be the case.

> In many tasks, moderately high fatiguing activities will impede performance rather than learning; that is, learning occurs all of the time, but fatigue depresses performance for a short time lowering the levels of achievement (Singer, 1975, p. 206). The fact that learning is not affected by fatigue gives some encouragement for trying to teach motor skills when the students have been in fatiguing activities (Schmidt, 1972, p. 240).

The amount of learning that takes place while in a moderately fatigued state may differ somewhat from the amount of learning that takes place while in a rested state.

The knowledge that others are present or will be present can have a strong effect on performance. Drowatzky (1975) stressed three types of social settings that can affect performance. The three areas are: 1) the effects of others being present as passive observers (an audience); 2) the effects of others engaged at the same time, at the same task, but working independently; and 3) the effect of interaction with others. The presence of others might prove to be detrimental if the skill is complex and in the early learning stages. Even once the skill is well learned and there is high motivation, the presence of an audience can overstimulate and impair muscular coordination.

Included with audience effects is stress, which is the demands that the environment places on an individual and make changes in performance (Fitts and Posner, 1967).

Mental practice defined by Bell (1970) referred to the cognitive rehearsal of a motor skill which can be accomplished with imagery, which is the thinking about a movement that is performed. Physical practice is superior to mental practice, but mental practice has been found to be highly effective during initial skill learning.

The place of mental practice should concern the teacher. Because of situations that sometimes cannot be controlled, all students cannot practice physically at the same time. An effective way to use some class time as suggested by Bell (1970) is to practice mentally while waiting for physical practice. This combination appears to be most desirable for physical education classes.

Massed and distributed practice cannot be discussed without referring to whole and part learning. The practice of a whole is either that of a total skill or a total activity. If a whole is a complete skill, then the parts are the elements which make up the whole, and the practice will consist of practicing these parts before they are combined into a whole. The factor which determines which method should be used is complexity. Relatively simple skills should employ the whole method. More complex skills require some sort of breakdown (Holding, 1973).

Singer (1975) sighted practice as a necessary prerequisite for learning skills. The practice of a skill must be purposeful with the learner attempting to attain a goal. The time in which the learner wants the higher level of skill to be available is a more significant factor than the method used in attaining a goal (Lawther, 1977).

Drowatzky (1975, p. 211) emphasized two types of growth processes. First the 'primary growth' which appears early and is facilitated by distributed practice which appears to increase as the length of the rest periods increase. Second the 'secondary growth' which comes later in learning and is enhanced by reducing the distribution of practice to the point where it becomes massed.

Drowatzky (1975), as well as Holding (1973), saw the choice of massed and distributed practices often time being one of economy, because the total time for distribution practice plus rest may eliminate its use. Although distributed practice might be critical if the performance requires accuracy during the time it is being learned, this would then eliminate massed practice. In general, massed and distributed practice, when administered within reason, are equally effective in promoting learning (Singer, 1975).

Johnson and Lockhart (1970) noted in their laboratory studies on massed and distributed practice, that as early as 1885 Ebbinghaus found that distributed practice was more effective than massed practice when learning such things as lists of nonsense syllables or numbers, and results of more recent studies involving the learning of motor tasks have generally agreed with those early findings.

Physical educators are in general agreement in their opinion that short, frequent practices are better and more profitable to learning than a long session in a brief span of time. Although caution must be taken when applying inferences from one method to the next, distributed practice is superior to massed practice for immediate performance in a variety of tasks (Singer, 1975). These short interspersed rest periods within the practice seem to increase the amount of learning. They are especially helpful to children who usually sustain interest in specific activities for a more brief time period than adults, and when the task is difficult and fatiguing. The time also allows for mental practice to take place.

In coaching, the demands of preparing a team to play may necessitate the massing of practice. The coach frequently cannot distribute the practice schedule for a skill over several weeks, so skill learning must be done within a short period of time in order to provide the player with the needed skills to compete. In this case, massed practice is preferable if the skill level of the player is high and peak performance on a well-learned skill is needed. Massed practice may also be preferable when the skill is meaningful and motivating, and when there is transfer from a previously learned task to a new task (Sage, 1977). If the factors of bodily and outside interference do not occur, massing practice seems equally effective to distributed practice. The massed practice has the additional advantage of reaching higher skill levels sooner (Lawther, 1977).

Based upon the analysis of the literature collected, it can be concluded that all living organisms are capable of some level of learning. The nervous system is responsible for the reception and transmitting of all the stimulus activity that occurs in the organism. As stimuli is picked up by the receptors, the data is converted into electrical signals and brought to higher levels in the nervous system. The data may then go to some memory store where it may be used for transmissions. When needed, the data goes to the motor neurons or effectors and the response occurs. For learning to occur, receptors, the higher levels of the nervous system, memory, effectors, and the response, is required.

A number of variables may affect the learning that is to take place. Knowledge of results informs the individual as to whether the response given is correct or not. Feedback, too, is a confirmation of the response. Motivation is that which causes one to act or perform with incentive. The affects one task has on the learning of the next task is known as transfer, which can be either negative or positive. Physical fatigue may affect learning, but more often will affect performance. Stress from audience may make some changes in performance and in learning during the early stages of learning. There are two types of practice that may affect learning. First mental practice, which is highly effective during the initial stages of learning; and physical practice, which is superior to mental practice and a necessary prerequisite for skill learning. Educators generally agree that the best type of physical practice is distributed practice, which is rest intervals between a set of a few trials, which is superior to massed practice, little or no rest between the beginning and completion of practice.

Basketball Coaches and Researchers Views of Massed vs. Distributed Practice of the Basketball Free Throw

Many basketball coaches and researchers agree on the importance of free throw shooting practice, although they may differ in their opinion of whether the massed or distributed practice should be used. Sharman (1965) emphasized that coaches should work to improve free throw shooting more than any other phase of shooting, because free throws are the only exactly similar shot each player will have more than once. Sharman suggested the use of the distributed method of free throw practice with the player stepping back off the free throw line each time he shoots. Following this suggestion, a player would avoid getting into an unnatural occurance that would not exist in a game. Other authorities (Cousy, 1976; Cooper and Siedentop, 1970) agreed with this method in that every practice session should take place under as near game conditions as possible. Pinholster (1960) noted that distributed learning helped eliminate fatigue, which may cause an unhappy memory to be associated with the attempt. This, then, could cause a resistance to later repetitions.

In the study by Davis (1964), he noted that Sweet emphasized the developing of a muscular pattern for shooting free throws. He suggested remaining on the free throw line during the full series of shots to be taken. In this method, massing of practice would occur.

Wooden (1966) followed this same massing method early in his practice season, but as the season progresses, fewer shots are taken in progression until it becomes distributed shooting. After this time, if a player hits a "slump", Wooden encourages the massed method to be utilized until satisfactory success is regained.

From the views of basketball coaches and researchers, we can conclude that there is not one totally accepted practice method in free throw shooting. Both methods have their benefits to free throw shooting, although the majority of basketball authorities tend to favor the distributed method.

Related Studies

It is very difficult to generalize about massed and distributed practice because research findings are contradictory. This may be due to the differences in the definitions of massed and distributed practice. In some definitions used in other studies massed practice is used to refer to trials completely uninterrupted by rest (Griffith, 1932; Singer, 1965), or in terms of the number of minutes per day (Knapp and Dixon, 1950; Knapp, Dixon and Lazier, 1958; Kleinman, 1976), or number of days per week (Young, 1954; Austin, 1975). In some studies distributed practice refers to trials interrupted by seconds (Griffith, 1932; Ryan, 1965; Kleinman, 1976); in others by days (Young, 1954; Singer, 1965), and in others by weeks (Harmon and Miller, 1950; Austin, 1975).

Working with two groups of basketball players, Griffith (1932) had one group shooting continually for one hour; and the other group shooting three minutes, resting two minutes for a total of one hour. Those who practiced with the two minutes of rest averaged fifteen percent more baskets than when shooting continuously.

An additive pattern of practice was studied by Harmon and Miller (1950). Females with no previous experience in billiards were divided into four groups. Group one had nine practices, three times per week for three weeks. Group two was the additive group with practices held on day 1, 2, 3, 5, 8, 13, 21, 34, and 55 of the testing period. The days that practice was to be held was determined by adding the previous two days of practice. Group three practiced daily for nine straight days, and group four practiced one day per week for nine weeks. Subjects shot fifty shots per practice. Results showed that the additive group showed a greater mean gain than the other three groups. Harmon and Miller concluded that massed practice during the initial practices is better than widely distributed practice. Since billiards also is a motor skill, this study by Harmon and Miller has significance to basketball in that these group practice methods can be applied to practice methods for basketball.

Using the motor skill of juggling, Knapp and Dixon (1950) divided seventy male college students into one group that would practice five minutes per day and another group practiced fifteen minutes every other day. Practice ended when the subject achieved 100 consecutive catches. Results showed that the five minute group reached the goal of 100 consecutive catches in significantly less time than the fifteen minute group. The fifteen minute group learned the skill in fewer practices, but the total number of minutes was greater. Similar practice methods may be used to help improve free throw shooting accuracy in basketball.

The juggling experiment was repeated by Knapp, Dixon and Lazier (1958) with high school boys, with the alteration of practice being interrupted by weekends. Results showed the five minute per day group learned to juggle significantly faster.

Young (1954) researched the rate of learning in badminton and archery classes. Two days per week of practice was compared with four days per week for nineteen practices in badminton and archery. Results in badminton showed significant differences favoring the two-day group. Results in archery showed significance in favor of the four-day group. Both badminton and archery have principles that are used in basketball skills. The practice methods used in these two sports researched relate closely to those of basketball.

Ryan (1965) studied the effects of varied rest intervals on stabilometer performance using eight groups of male subjects. Eleven trials of thirty seconds each were given to all subjects in the groups. Varied rest periods per group were ten, twenty, thirty, and forty seconds. In addition to this, four groups were given a five minute rest after the eighth trial. Ryan found no significance between rest intervals in the first eight trials or between groups on the last three trials. This stabilometer study has practice methods that can be applied to practice methods used in shooting practice in basketball.

Singer (1965) studied massed and distributed practice on a novel basketball skill of bounding the basketball into the basket from the free throw line by college males. He used three groups. Group one practiced eighty continuous shots. Group two shot twenty shots, then had five minutes of rest for a total of eighty shots. Group three rested 24 hours between each set of twenty shots. Immediately following the test period the 24 hour group showed significant improvement over the other two groups. One month later with no practice between the conclusion of the test period, the two massed groups performed better than the 24 hour group.

Using the fine motor task of foot tracking, Whitley (1970) gave two groups of 30 college males 35 trials in either massed practice or distributed practice methods. Results showed that distributed practice was significantly better in performance but learning was significant for both groups. The methods used in this motor learning study are applicable to the shooting methods used in basketball.

Austin (1975) examined the effect of massed and distributed practice upon the learning of a velocity task. Three groups were used in the testing: a massed, a distributed, and a control group. Each subject practiced 50 throws during a week. The massed group completed all throws on each Wednesday of the six week testing period. The distributed group practiced 10 throws on each weekday, and the control group did not practice during the six weeks. Results revealed the distributed practice superior to the massed and control groups. Similar practice methods may be used to help improve free throw shooting accuracy in basketball.

Kleinman (1976) divided 80 college students into two groups practicing three criterion tasks: the floor kip, the front hip circle mount, and the glide kip. Minutes of continuous practice were compared to seconds of practice with minutes of rest in a set. The results showed no apparent significant difference with either method upon the tasks. Some of the methods of practice may be applied to many of the skills learned in basketball.

These findings suggested that there is an interaction between the nature of the activity and the type of practice which is best (Bell, 1970). The studies provide insight into the many different definitions which can be given to both massed and distributed practice methods. It can be noted that many different motor skills can use massed and distributed methods of practice, but not all motor skills use them in the same manner, and all motor skills will not be successful with just one practice method. These studies should be used to determine if one method has a significance over the other in the learning of a specific motor skill.

Use of Fifth and Sixth Grade Boys in Testing Procedure

Sex difference in motor performance become more apparent with increasing age. Even in children from the ages of five to seven years, it is possible to notice differences in the manner in which they perform physical skills. This is largely due to the physical maturity of different individuals, although sociological implications may become apparent.

Cratty (1973) noted that:

Boys as young as three and four years seem to use more of their bodies when throwing than do girls of the same age (p. 226). At the ages of five to seven and nine to eleven, research shows that boys perform higher in tests of running, jumping, catching, striking, and kicking (Singer, 1975, p. 344). As adolescence is being reached, girls fail to perform to their potential, but boys use their full capacity to do well in motor skills (Cratty, 1973, p. 227).

Henry and Nelson (1972) found in their research on age differences between ten and fifteen year old boys in gross motor performance that the amount of learning was greater in the younger boys than that observed in the older group. Noted also was that on the average, the younger boys learned more than the older boys before the plateau is reached.

In conclusion, the fifth and sixth grade boy tends to be at that age where the greatest amount of learning will be observed. His final skill is more determined by his ability to learn than is characteristic of boys at an older age.

Use of the Ten Foot Free Throw Line in Testing Procedure

In pilot studies by the researcher and by Miller (1971), results showed that nine, ten, eleven, and twelve year old boys had difficulty in shooting the ball the required distance of the free throw line. Miller therefore reduced the distance of the free throw line from fifteen to ten feet. The three to two reduction ratio is in accordance with the change made in free throw distance for Biddy Basketball rules (Archer, 1966).

From these studies it can be concluded that nine, ten, eleven, and twelve year old boys need a ten foot free throw line in testing procedure if an accurate indication of learning is to be indicated.

Use of the Nine Foot Basket and Intermediate Basketball in Testing Procedures

Miller (1971) stated that when fifth grade boys are involved in shooting tests using a regulation ball and basket, they do not give an accurate indication of the learning that takes place compared to when subjects have practiced with a smaller ball and a lower basket. Miller also quoted Louis Bazzano, Supervisor of Elementary Physical Education in the Hartford (Conn.) Public Schools, as saying,

> With a smaller ball and lower basket, a ten or eleven year old can learn to shoot with good form and as a result will develop into a better shooter at an early age (p. 13).

Other noted authorities of physical education in the elementary school (Dauer, 1965; Sehon, 1953; Anderson, 1952) suggested that in an elementary school program an intermediate sized basketball and baskets lowered to nine feet should be used to adapt a basketball unit to the children.

It can then be concluded that fifth and sixth grade boys will benefit more from a nine foot basket and an intermediate basketball than from the regulation sized basket and basketball. These adaptions are necessary because the fifth and sixth grade boy has not yet reached the physical maturity necessary for the use of regulation sized equipment.

Use of the Warm-up in Testing Procedure

Athletes often prepare themselves for athletic events by engaging themselves in a pre-event ritual. These rituals known as "warm-up", are often in the form of the skills that they will be required of the athlete in the event. It presumably prepares the athlete for competition. Singer (1975) believed that "warm-up will probably be more beneficial for those skills that require a great deal of precision, timing, and coordination, and especially if there is a long layoff from the last experience to the present event" (p. 374). Skaggs (1972) viewed warming-up as:

> Largely a matter of attitude, mental alertness, and attention. It takes some time for the subject to become absorbed in his task and to disengage his mind from other matters" (p. 269).

"Effectiveness of muscular contraction depends on temperature" (Karpovich and Sinning, 1971, p. 29). Since during physical activity muscle temperature rises, it is believed that muscles are warmed-up some way before work. Besides an increase in muscle temperature, "blood circulation rate and volume are augmented and also pulmonary ventilation and oxygen transportation" (p. 30).

It can then be concluded that in order to prepare the body and mind properly for a physical event, warm-up is a necessary prerequisite to practice. The period of time used for warm-up should then prepare the individual's mind for the task at hand, and prepare the body by raising the temperature in the muscles and increasing other body functions.