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A COMPARISON OF VIDEOTAPE REPLAY WITH
A TRADITIONAL APPROACH IN THE
TEACHING OF SELECTED
GYMNASTIC SKILLS

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

By
Elliott Ray Plese, B.S., M.E.

* * * * *

The Ohio State University
1967

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INTRODUCTION

The challenge facing education is greater today than ever before. It seems that so much has been accomplished in the last few decades that there is hardly any basis for comparison with what man has done in preceding centuries. Whole new areas of learning are continually being opened up before we have had time to assimilate the old ones. In addition to the advancement of educational knowledge into new horizons, the established fields are also being enlarged. Couple these facts with an expanding school enrollment, which will continue to increase unless curtailed by a major catastrophe, and one can soon realize the problems faced by education. Unless we take steps to alleviate this situation, the years immediately ahead will be still worse for "the essence of the crisis in education is that we have too few teachers for too many students."\(^1\)

As soon as educators realized the problems they were to face, they began to make plans to meet them. They began seeking to implement improved methods and techniques in order to provide improved programs. Trained leadership and intelligent experimentation was brought to bear on the

\(^1\)Charles A. Siepmann, *TV and Our School Crisis* (New York: Dodd Mead and Company, 1958), p. 3.
educational scene in order that the purposes of the school might be more clearly defined and the means for achieving these purposes better determined. On the local level buildings were planned, financed and built. At the state and national level seminars were planned which revealed a need for additional help outside the field of education. The philanthropic agencies responded; for they began to see the problems encountered by education. They set up research programs to develop new materials and techniques. Their studies revealed that no one answer would solve so complex a problem; however, there was every indication that teaching aids had to be developed and evaluated.

In their research work many aids in the form of electronic devices were studied. One of these, educational television, appeared to show the most promise. There appeared to be every indication that this media, thought to be one of the most significant technological developments since the printing press, would provide one solution to some of the problems confronting education.² It gave every indication of being an instrument that would be an effective tool of instruction; for, it provided the necessary means of reaching a greater number of students

thus providing a possible solution to the teaching shortage. The question was not whether educational television would be used but how it would be used.

As is the case with any innovation, the early use of this media created problems because of the unavoidable pains of accelerated growth. The knowledge concerning the efficiency of the medium was severely limited and inadequate and, therefore, would not permit generalizations or long range predictions about its use. Further experimentation was necessary to determine the efficiency of this instrument in communicating educational information.

With the great expansion in the use of visual aids and a wider acceptance of movies as a method of providing feedback, knowledge of correct results, and reinforcement in motion analysis, there was every indication that television could accomplish this more effectively. Moreover, with the recent invention of videotape replay and the knowledge that a motor skill is acquired more readily when immediate knowledge of the accuracy of the response is given in such a way that the internal or kinesthetic cues are emphasized, it seemed imperative that someone attempt a study utilizing this information. Without a doubt, the efficacy of this instrument rested in its ability to provide an immediate visual element to motor performance. With its use, it appeared that immediate feedback and knowledge of correct results with reinforcement would produce changes that would affect, in
some part, the response sequence. Also, wherever refined motor movement is considered essential in the performance of an activity, there appears to be a problem of finding the most efficient and economical way of teaching that activity. Since all motor skills are accomplished by movement, the visual study of that action would appear to be a most valuable approach to finding a more efficient way of teaching and thereby acquiring that skill.

Careful consideration of these various aspects suggested an obvious need for research involving a comparison of immediate feedback using videotape instant replay with the traditional approach in the teaching of a motor skill.

Statement of the Problem

A comparison was made of immediate videotape replay with traditional educational approach in the teaching of selected gymnastic skills.

Purpose of the Study

The purpose of this study was to compare the results of teaching selected gymnastics skills using videotaped immediate replay with the traditional teaching approach. The data gathered from this study was used to statistically compare the effectiveness of immediate videotape replay in teaching a gross motor gymnastic skill with the conventional approach.
Definition of Terms

Conventional Method—instruction given to the students whereby they must depend solely upon verbal instruction, demonstration, practice, and verbal correction; also, they must rely strictly on verbal models and kinesthetic perception with occasional visual demonstration by the teacher.

Experimental Group—the eighth-ninth grade physical education gymnastic classes who have two periods of forty minutes each per week of a supplementary videotape replay critique of their performance.

Feedback—in behavior, sensory stimulation resulting from a response; this may be sensation from the movement itself or the change of external stimulation as the moving hand touches another surface or as the eye in its new angle of regard sees different objects.\(^3\)

Instant Televised Instruction—simply means that a videotaped instant replay console was utilized to provide immediate feedback or correction connected with the process of learning a selected skill.

Instructional Television—any instruction or program using the medium of television to add to the quality of instruction offered.

---

Motor Ability—the level to which one has developed his innate capacity to learn motor skills.  

Motor Capacity—innate potentialities; the limit to which the individual may be developed.  

Motor Educability—refers to the ease with which an individual learns new skills.  

Motor Learning—learning in which the task is described in motor terms.  

Motor—pertaining to muscular movement or that to which causes movement.  

Reinforcement, autogenous—the strengthening of an imperfectly established behavior pattern or stabilization of a recently established one by untutored, "natural" trials or exercise; that is, trials or


8 Ibid., p. 331.
exercise stimulated by normal physiological and environmental factors.\(^9\)

Limitations of the Study

This study was limited to fifty-four junior high school students in the public school system in the city of Fort Collins, Colorado, a community with a population of approximately 36,000.

Variable Controls

1. All subjects received instruction in physical education the same number of periods a week.

2. Students with recent serious illness were excluded from the study.

3. Youngsters with physical handicaps were excluded from the study.

4. Students with a normal range of intelligence were selected for the study.

5. Selection was made on a voluntary basis.

6. Any student with previous training on the parallel bars was excluded from the study.

REVIEW OF LITERATURE

The accelerating pace of the twentieth century has necessitated a merging of the functions of many allied disciplines in educational research. Educational historians of the future will probably report that the period encompassing the two decades from 1950 to 1970 provided intensive research in the development of instructional media; such as, television, programmed learning, and other automated teaching devices. They will probably also be able to recognize the need for the student of this era to learn more than ever before because of the explosion of human knowledge and the apparent lag in educational methodology during this time. Also, there is a likelihood that evidence from this period will indicate that this research became a necessity because of the rapid growth of a population that desired an education and by the predicted and actual shortage of competent teachers. They will be able to find ample evidence of the problems facing educators of this era. As Thomas et al. stated in 1963:

At the present time we are faced with a critical shortage of teachers and instructors, insufficient accommodations, inadequate facilities and equipment, and a training programme
for teachers which is unlikely to produce the trained personnel to meet the ever-increasing demands for education and training. The position is further aggravated by a tendency to cling to teaching methods and techniques which have proved to be inefficient, ineffective and uneconomical and which cannot be reconciled with our present economic and social needs.¹

Therefore, it would seem that the problem facing the educationalist is that of finding the best possible means of harnessing the recent technological advances and being able to provide an environment in which the accepted learning principles can be realized. Although individuals have made great advances, Clark believes that with the establishment of dissemination and implementation centers we would realize the low level of quality production which would then place educational research in a position to upgrade the quality of our research efforts.²

Although there is evidence of many experiments involving the use of various types of instruments and television in education prior to 1959, the rapid growth of television did not take place until after the Federal


Communication Commission lifted the restriction it had imposed upon its use.\(^3\)

The great volume of research on film and television was made possible largely by the considerable amount of financial support provided by the philanthropic foundations in the mid 1950's and more recently by the federal government through such agencies as the Office of Education.\(^4\)

However, many individuals believed that in order to advance we must make provisions for more money in educational research. Wolfle pointed out that the cost of research is going up and in order to advance it would become necessary to establish a "cost of research index."\(^5\)

The value of television video replay is centered upon the immediate knowledge of results. Examples of this type of learning can be found in antiquity in such European devices as Pascal's arithmetic machine and the mechanized planetary devices that provided the learner


with the relative movements of the planets in relation to the signs of the zodiac.\textsuperscript{6}

Classroom instrumentation in the ordinary school has, in most instances, been limited to such instruments as a blackboard, chalk, and the writing material provided by the school. However, since 1920 there have been marked improvements made in the types of instructional devices provided to the teacher. In the modern classroom, in most instances, every attempt is made to provide the student with feedback from his own learning activities.\textsuperscript{7}

Recognition of the importance of this immediate feedback as an aspect of the learning process can be found in the beginnings of educational theory. Thorndike, in 1914, wrote:

\begin{quote}
If, by a miracle of mechanical ingenuity a book could be so arranged that only to him who had done what was directed on page one would page two become visible, and so on, much that now requires personal instruction could be managed by print.\textsuperscript{8}
\end{quote}

He also stated that practicing an activity did not necessarily improve it; for, if the same thing happened every time, the student could not improve. He

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\textsuperscript{7}Ibid., p. 77.
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believed that repetition is useful when the pupil is given a chance to vary what he does "to select for use the variations which improve the ability and to eliminate those which weaken it."³

Unfortunately, Dr. Thorndike's appeal went unheeded until, in the early 1920's, when Dr. Sidney L. Pressey of The Ohio State University designed a mechanical device for testing and scoring. Originally designed to primarily be an automatic testing device, it soon became apparent that it had instructional properties and attracted great interest from the educational profession. With this instrument, he believed it could be possible to perform certain routine functions normally provided by the teacher in classroom drill and recitation. He also believed a few minor changes in the design could help supply the student with immediate information concerning the correctness of each response.¹⁰

In 1927, Pressey began to realize that it would be possible for the student to regulate the learning process in accordance with the principles of learning. He seems to be the first educator to make systematic attempts to provide the student with an immediate knowledge of results using the known laws of learning. His

³Ibid., p. 111.

efforts to accomplish this are evident in both of his early works.\textsuperscript{11}

As a result of his initial labors, Pressey began to develop additional insight into the importance of immediate reinforcement. However, his primary concern was still focused upon a means by which the teacher would be free "from the drudgeries of her work so that she may do more real teaching, giving to the pupil more adequate guidance in his learning."\textsuperscript{12}

He apparently became disgusted with the lag in the acceptance of his ideas, because in 1932 he wrote:

The problems of invention are relatively simple; with a little money and engineering resources, a great deal could easily be done. The writer has found from bitter experience that one person alone can accomplish relatively little and he is regretfully dropping further work on these problems. But he hopes that enough may have been done to stimulate other workers, that this fascinating field may be rapidly developed.\textsuperscript{13}

Prior to this article, the worth of the first work of Pressey was beginning to go through the first research evaluation of his self-instructional concepts. Peterson initiated a series of experimental evaluations of his inventions and concepts and confirmed their

\begin{flushright}
\textsuperscript{13}Ibid.
\end{flushright}
effectiveness in promoting learning when used with both accelerated and conventional classes. From this evaluation he also reported that the students showed a strong preference for the automatic self-checking device. He believed that the immediate knowledge of result feedback was the significant factor in his findings.\textsuperscript{14}

A carefully controlled experimental evaluation of the original machines developed by Pressey was carried out by Little in 1934. In his experimental design he used an experimental and control group that were paired on the basis of general intelligence scores. Although both groups scored higher, the more pronounced differences were found with the poorer students. Those who used the teaching machines were farther ahead of their paired controls.\textsuperscript{15}

In the latter part of the 1940's, the work of Pressey initiated a series of experiments investigating the importance of immediate knowledge feedback. Angell and Troyer reported that an immediate knowledge of results significantly enhanced learning because:

In general, techniques whereby a student gains immediate knowledge of test results aid


directly in the realization of a major goal of education: to help the student to increase ability in self-evaluation, to identify his own strengths and weaknesses in such a way that he may direct subsequent learning efforts more intelligently.\(^\text{16}\)

Jones and Sawyer investigated the above research stating that the remarkable potentialities of the study were focused upon "... the principle that benefits derived from desirable evaluation procedures are enhanced by immediate knowledge of results. ..."\(^\text{17}\)

A summary by Pressey in 1950 reported results indicating the efficacy of immediate knowledge feedback in promoting learning. As in most of his studies, he concluded that it was extremely valuable and educationally beneficial for the student to receive an immediate knowledge of the accuracy of his answers during the testing process.\(^\text{18}\)

In later evaluative studies by Stephens and Severin, students of Pressey, the former revealed that errors were eliminated more efficiently when the students


could correct their errors immediately. The latter concluded that for short easy tasks, the automated teaching device was of little value; it was enough just to point out the correct way.

An analysis of the work of Pressey and his students will reveal a persistent and original attack upon some of the problems associated with the principles of learning. He was the first experimenter to attempt to mechanize teaching which he believed would permit a controlled objective analysis of meaningful learning. The results of years of educational research led this far-sighted educator to report that machine teaching utilizing the response-programmed material theory was not sufficient in itself; however, he believed it would be a useful adjunct to the other teaching methods.

During the mid 1950's the self-instructional devices and techniques that had been developed incorporated most of the significant features that are found in


contemporary machines. Most of these instruments had been subjected to considerable research and controlled experimental evaluation with favorable results. However, Pressey's hopes for an "industrial revolution" involving his machined instruction did not begin to be realized until 1954, when Skinner published his paper in which he attempted to apply the concepts developed in the laboratory directly to the classroom. The real impetus to machine teaching and programmed learning did not come from the work of Pressey but from the works and writings of Skinner and his associates. Skinner introduced concepts that included new terminology such as "contingencies of behavior" which he defined as "the relations which prevail between behavior on the one hand and the consequences of that behavior on the other—with the result that a much more effective control of behavior has been achieved."22

As a result of these early pioneers various investigators attempted to determine the value of their research. The literature was replete with new theories about the effect of immediate knowledge of results upon learning. Greenspoon and Foreman found that a small delay in the time a student observed his response decreased the rate of learning. Their investigation demonstrated

the "efficacy of immediate knowledge of results in the learning of a motor task."²³

Since Skinner's entire theory was based upon laboratory work centered upon the learning of animals, many of the early investigators were hesitant to accept his reinforcement theory. During this time, reinforcement was considered to be a reward of food offered to the animal after the investigator observed a desired performance.

Many investigators doubted these theories because they were based upon carefully controlled laboratory experience. However, a great number of researchers studied the effects of verbal reinforcement upon the actions of human subjects. Buss et al. made a study using human subjects and provided them with an immediate knowledge of correct results. They determined that verbal reinforcement was a useful tool and that it could be used as a means of reinforcing the human.²⁴

The principal innovation of Skinner was to recast the whole idea of self-instruction into a new thought involving the reinforcement learning theory. He discounted the work of Pressey primarily because most of his


original research was concerned with testing and with the elimination of menial tasks that had to be performed by the teacher. Skinner believed the important ideas gleaned from teaching machines and programmed instruction were derived from his analysis of operant conditioning. He based his entire theory upon a description of the techniques he and his colleagues had developed to control behavior and learning in animals. In their research studies they had discovered that any response emitted by an animal could be reinforced and that a desired behavior pattern could be established by reinforcing first a response that resembles what is desired and then strengthening successive approximations of the desired pattern. He claimed that the species of animal made very little difference in the efficacy of his techniques because he had obtained comparable results with pigeons, rats, monkeys, dogs, and human children. He also realized that this could only be used as a single tool in the educative process and that it had to be manipulated with considerable precision. In the findings, he predicted that these new principles and methods emerging from the study of reinforcement could possibly prove to be among the most productive social instruments of the twentieth century. He based his whole idea upon the reinforcement theory because he believed the school teacher possessing the knowledge could apply them to their classes, thereby achieving
a more successful control over learning. As a result of his studies, he concluded that the ordinary schoolroom practice was shockingly inadequate for controlling learning and that reinforcement was almost entirely aversive; for, the child reacted to escape aversive consequences rather than to achieve positive rewards. The greatest weakness to the system is that the child is not able to determine the correctness of his response, in most instances, until days have passed. As a result of this, the child's learning process is greatly reduced. Skinner believed that in the present classroom the pupil could not be reinforced after every response, as they should be, but only after blocks of responses had been made. 25

In 1958, Skinner reported that progressive education was only a temporizing measure which should be supplemented by more effective means of instruction. He suggested the use of teaching machines; because, they were able to replace the aversive practices used in the classroom and could be a more powerful adjunct to the learning process. He believed that in order to build an educational system that would meet the present demands without sacrificing our democratic principles it would become necessary to thoroughly explore the use of teaching machines. His work had progressed in such a manner that

he was sure that specific forms of behavior could be elicited and brought under control by providing specific classes of stimuli. He stated that the most important aspect of the teaching machine was the provisions made for the student to receive knowledge of results so that he could be reinforced immediately. 26

Where teaching aids are to be used to present a variety of learning situations, there is ample evidence to support the use of movie film. This tool allows the instructor to achieve some flexibility in the mode of presenting the instructional material and also makes allowances for the student to review his performance, thereby being reinforced but not receiving immediate knowledge of results.

Although the early physical educators were not cognizant of the terminology that had become popular in the other fields they did realize that education had been provided with a tool that gave a form of reinforcement. In 1936, Palmer stated:

Briefly it may be stated that some of the advantages of adding the sports motion picture to the physical-education teacher's materials are as follows:

1. Through slow-motion analysis of sport technique, it is possible to follow: (a) positions of the body, (b) execution of movement,

(c) planes of movement, (d) relation between different parts, (e) handling of equipment, (f) muscular exertion, and (g) plays of teams.

2. The film affords an opportunity to view the separate skills used in a game not only under playing conditions but when practiced in isolation from the game.

3. The timing element which is so important in sport performance can be clearly shown.

4. The contrast between good and bad form can be shown to an advantage.

5. Students with poor coordination could gain much through the use of the "endless loop" type of film which would repeat specific technique.

6. The "close-up" is an advantage in teaching large groups.  

Priebe and Burton also discovered this technique could aid in coaching. They concluded that the use of slow motion pictures allowed the student to make better achievement and faster progress in learning the high jump. They also believed that it was possible to eliminate trial and error during the initial period of learning this skill. They stated that this method was "definitely superior to verbal direction and physical demonstration of good form, particularly during the initial period of learning."  


able to increase the interest and attention span of the athlete; and they also found a significant decrease in the instructional time. They stated that there was a definite assistance given to the performers when they were able to view themselves and change from a familiar form of skill to an unfamiliar form that allowed them to become superior performers. 29

Lockhart undertook a study to determine the value of motion pictures in the teaching of motor skills. She stated that the evidence seems to indicate that the use of motion pictures was of most value after the student had achieved a certain proficiency in the motor skill. She also found that this was evident to support her belief that motion pictures were of definite value in teaching. 30

In 1948, Brown and Messersmith reported their experimental group made a little more progress than the control group when they attempted to teach tumbling using films as a visual aid. They believed that the major factor in their findings was caused by the tendency for the student to be highly motivated

29 Ibid., pp. 192-198.

while motion pictures were made of their performance. Nelson discovered an interesting feature about learning when he found that motion pictures seem to favor the subjects who possessed a lower level of skill, while the reverse was true with those individuals in the upper levels. He used the slow motion loop film method while attempting to teach golf.

Lockhart investigations supported the findings of Nelson. In 1960, she reported that by the use of visual aids it was possible to study the timing element which she believed was extremely important because the beginner was allowed to view good and poor form. She also found that the visual aid was of utmost importance to the beginner during the early stages of learning, becoming less important as the student reaches the upper levels of an expertness.

An important conclusion that can be drawn from many studies concerning the effectiveness of film use was made by Sol. M. Roshal, when he discovered that

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for film to be particularly meaningful to the learner the motion picture was more effective when the act approached the representation of the learner himself performing the desired act. 34

From the many studies made in physical education concerning the value of motion pictures, it appears that the nature of effective cues and prompts in the instruction of a motor skill resides in the special attention-focusing mechanism of the individual seeing himself performing the activity. Clifton and Smith studied the effects of the individuals viewing themselves while attempting the motor skill of throwing and found that "significantly more positive scores were obtained from the experimental subjects after they view films of their performance." 35

With motion pictures it seems education has a special attention-focusing cue that is useful in the correction of faults found in the performance of motor


skills for "... baseball players who receive batting instruction and view motion pictures of their batting can significantly decrease the number of batting faults they commit..."36

The flexibility of this instrument in the teaching of a motor skill can be determined by the many areas in which it serves. Haskins used it in response recognition in tennis and found it shortened the time it took the subjects to accurately perceive the direction of a tennis return.37

It appears that the important aspect of motion pictures is the allowance of the learner to make a desired response to a relevant cue. It provides the learner with optimal timing of his actions with that of the correct movement allowing for the necessary corrective changes that need to be made. In the long run, it appears the important thing is that it promoted practice in the desired response by one means or another.38

As important as motion pictures have become to the physical educator and coach, the development


38Karl U. Smith and Margaret Foltz Smith, op cit., p. 144-169.
processors have not been able to refine their technique to the extent that they can provide service that will give an immediate knowledge of results. Bigge, in discussing the excessive time lapse between a behavior and the reinforcing event, stated that "unless explicit mediating behavior has been set up, the lapse of only a few seconds between a response and its reinforcing event destroys most of the effect." He continued by stating the "reinforcing stimuli should follow the response immediately." 39

Smith et al. stated that they believed that videotape recording provided the researcher with a technical achievement that would make significant contributions in future studies of human perception and motion. 40

Smith and Smith reported that videotape replay is highly useful in training high-speed or complicated maneuvers such as that which is found in athletic performance.

They state:

A televised record of a performance pattern can be played back immediately to the performer to point out his errors or weakness in control. Immediate visual knowledge feedback of this


sort is inestimably more valuable than any amount of delayed verbal analysis and instruction.\textsuperscript{41}

Many studies have been made concerning the effectiveness of educational television as a teaching device. The literature is replete with arguments for and against its use in the classroom. Much of the controversy seems to center upon the fear of replacing the teacher with this electronic tool; however, there is ample evidence that indicates the intent is not to replace the classroom teacher but, without a doubt, his role will be greatly changed. As Siepmann stated:

> It is foolish and beside the point to argue that this kind of teaching can never replace normal teacher-student relations in the classroom. Obviously, it cannot, will not, should not. No one ever said it could. This is argument by irrelevance. The proper and pertinent question is what place such teaching has in the over-all experience of students at school.\textsuperscript{42}

Cassirer reported that there are some controversies concerning the weaknesses and strengths of teaching that are glaringly revealed by television. In whatever form it is used, it becomes a catalyst in the wider process of evaluating education as a whole. Traditionally, the teaching profession has relied on instruction presented in an intimate and personal environment; therefore, there is initial skepticism about this electronic tool.

\textsuperscript{41}Karl U. Smith and Margaret Foltz Smith, \textit{op cit.}, p. 118.

\textsuperscript{42}Charles A. Siepmann, \textit{op cit.}, p. 93.
The resistance is enhanced by the fact that educational administrators and foundations, not teachers, promoted the introduction of television into the schools. Cross and Cypher stated:

Television is the most powerful single medium of communication developed by man. It is likely that no invention will have a greater influence on man's behavior or on society's course of events during the next one hundred years than this system of projecting our visual senses.

Listed in the Educator's Encyclopedia are the following advantages of instructional television:

1. The best teaching can be made available to the observer.
2. Materials and equipment that are otherwise unavailable to the classroom may be used.
3. Programs can provide on-the-spot views that can be arranged in no other way.
4. Television provides a motivation of its own and ordinarily interests students.
5. Large groups of students can be instructed at the same time and later released to small groups for more individualized instruction.

Tettemer presented a comprehensive discussion of the values, limitations, and obstacles of instructional


television and concluded that schools will have to be drastically reorganized to make use of this instrument. He suggests that a re-examination of curriculum, class size, and self-contained classroom are necessary before adequate use can be made of this media.46

It is not the purpose of this review to provide a lengthy examination of the worth of educational television as a tool of instruction. However, it can be said that most studies reveal there is little significant difference between the overall effectiveness of classroom teaching and teaching by television. In a comparison of 393 schools and colleges using educational television, Schramm found in eighty-three studies television teaching was superior to classroom teaching while fifty-five studies revealed it was inferior. In the majority of the cases, 255, there was little significant difference between these two methods of instruction.47

Hayman presented the following based upon research and observations made of television teachings:

1. A substantial amount of learning takes place when fifth-and sixth-grade pupils


view expertly prepared television lessons in their classroom.

2. The amount of learning can be greatly increased if the context of this televised instruction is skillfully manipulated.

3. A second viewing of the television lesson is valuable when the pupil has not had additional instruction in the classroom. When other instruction is provided, however, the second viewing becomes less effective.

4. Many activities were found to be effective supplements to the televised instruction, but certain combinations of activities were considerably more effective than others.

5. In general, an eclectic form of classroom practice proved desirable. The eclectic method included structure drill, dialogue drill, narrative drill, and certain other practices.

6. Electronic aids, particularly those with feedback, proved valuable in most instances. This was especially true where classroom teachers were in the middle range of experience and preparation.

7. In general, the supplemental activities which provided more variety produced more learning.

8. In most of these supplemental activities, the pupils had some contact with a classroom teacher, and this teacher was of prime importance. In fact, a well-trained and highly motivated classroom teacher is the most effective single "learning aid" that a school can combine with instructional television.

9. Both the interest and the experience and preparation of the classroom teacher influenced learning. These were not related to each other, but they interacted on the dependent variables. Where teacher interest was high, pupil performance was directly related to teacher preparation and experience. Where teacher interest was low, however,
pupil performance was inversely related to teacher preparation and experience.\textsuperscript{43}

Brown \textit{et al.} believed that every new innovation had to suffer before acceptance. They compared the problems of the videotape recorder with that of the early sound motion picture projector. However, they believed that with the rapid advancement and new inventions, one of which would include color, it would only be a matter of time before videotape would be fully accepted in every realm of education.\textsuperscript{49}

Spaulding believed that the worth of television and videotape replay would be found in their ability to combine all other attempts in which machines were used in teaching. He believed that these instruments could combine teaching films, film strips, recordings, programmed instruction and teaching machines into one media for the expressed purpose of instructing the child.\textsuperscript{50}


Carpenter also recognized the versatility of the instrument; for he stated that every other media of instruction could be used with it. He also believed that this tool was "capable of handling with fidelity a range of semantic levels and complex patterns of communicative signs, cues, and symbols." 51

He continued by pointing out that many of the errors made regarding the instrument were attributing characteristics to it which were primarily characteristics of instruction. He realized that television could modify the form of a message but that a teacher had to supply the message. 52

The following description of behavior by Smith and Smith gives ample evidence of the value of videotape replay. They state the most meaningful aspect in describing behavior is a meaningful critique of the events of perception and action enabling the individual to adjust his motions to his perceived environment. They continue by saying:

It is our belief that motion and perception are inseparably related. The development of perception in the child is the development of motion, and the only valid understanding of perception at any level is in terms of the


movements that define it. The so called perceptual activities of delection and discrimination involve the adaptive movements of orientation and differential response whether these movements are large, easily seen, overt responses or minimal, implicit responses. The organization and stability of the perceptual field depend on movements of orientation, location, and differential manipulation that have become established in the motion patterns of the individual.53

In 1956, Smith et al. reported that television would be an important instrument in the future, especially "for analysis of the spatial and temporal organization of perception, motion, and other aspects of behavior in relation to the visual environment."54

Tanner succinctly described the problems associated with the use of this instrument when he stated, "The special characteristics of television need to be more fully understood. Its directness, immediacy, and visual eclecticism are not embodied in any other medium. Such attributes make television a unique medium for instruction."55 He continued with an analysis of the patterns of human behavior and the manner in which the individual emulated a parent, teacher, or peer. He wondered if this


emulation would be facilitated by the use of television.\textsuperscript{56}

An evaluation by McKinney revealed the major problem of acceptance of this instrument. He believed the great reason for a lack of acceptance was caused by the inability of the teacher to use it and compared its use with that of the vaudeville actor who was moved back into the studio.\textsuperscript{57}

Greenhill believed that in the past decade many things have become clear; evidence seems to indicate that research in instructional television would become more sophisticated and complex and would continue to be a subject of research. He stated that, "Television and videotape recordings, in particular, provide a marvelous vehicle with excellent control over stimulus materials to make research feasible and productive."\textsuperscript{58}

John H. Meier, Assistant Professor of Psychology at Colorado State College, Greeley, Colorado, discussed the use of videotape recordings in the training of teachers. He refers to this training process as microteaching

\textsuperscript{56}Ibid., pp. 243-249.


and states the power of the media can be found in subjec-
ting the samples of human behavior to the "5 r's;" re-
cording, reviewing, responding, refining, and redoing. 59

In an unpublished paper Meier stated that the most
dramatic factor in the typical employment of videotape
recording comes from optimal and immediate feedback of the
performance of the subject. He continued his analysis by
stating that although it was not essential to the teach-
ing process, it considerably enhanced the efficacy and
accuracy of its analysis because it provided instant
and, if necessary, repeated observations of any given
performance. He believed that the employment of the
recorder gave the teacher and the student an accurate
appraisal of the amount of verbal interaction that took
place during the teaching act. He also stated that its
use enhanced the principles that:

Learning under the control of reward is pre-
ferred and that success experiences make failure
easier to take. . . . It is apparent that the
video-tape replay of a person in action has a
certain autotelic nature to it. That is, the
experience itself of watching one's self is fas-
cinating for most people, and the activity con-
sequently has within it certain subtle rewarding
properties. 60

59John H. Meier, "Micro-Teaching Featured in
Laboratory Workshops," Newsletter, Vol. I, No. 2 (Dec.,

60John H. Meier, "Rationale for the Use of Micro-
Training with Teachers, Counselors and Learners," An un-
published paper on a project launched by the Rocky Moun-
tain Educational Laboratory and the Colorado State College
Experimental Project in Teacher Education, Greeley, Colo-
rado, 1966, p. 6. (Mimeographed.)
The worth of the television recorder in the field of athletics was pointed out in a 1964 Editorial found in the *Scholastic Coach*. At this time the media was used and found to provide a greater depth of training for the student but no reduction in teaching personnel. The use of the television recorder was found to be important only because it helped to do a better job of teaching.61

In 1966, Caine concluded there was no statistical difference in bowling scores between those taught with the aid of videotape replay and those taught using the regular instructional method. However, the experimental group only bowled before the videotape recorder once a week and were presented with a considerable handicap by having to bowl in an artificial environment created in the gymnasium. They had their performance replayed and analyzed for them by the instructor but did not bowl again until the next class meeting. He stated it would appear necessary to overcome these variables before adequate judgement could be made of this instrument.62


In an analysis of the total effect of television upon teaching, Suppes believed the problem was centered upon a lack of knowledge about what the instrument could do. He made a generalized statement that the more the media was used the better tool it would become for instruction.®

FEEDBACK

Educational psychologists have attempted to distinguish the differences that exist between the functions of the learning process. They have tried to separate the various segments of it into what the theorists call reinforcement, knowledge of correct results, and feedback. Although many researchers have attempted to distinguish between different functions or roles of feedback, they have not tried to divorce the feedback concept from knowledge of results or from reinforcement. It is the purpose here to show that differences do exist and that at times it is necessary and possible to make these distinctions clear. The most logical way to understand the differences that exist between these terms is adequately expressed by Wiener. He makes an analogy between a mechanical feedback system and man. He believes that the entire feedback system can be compared to the effector

system that governs the steam engine, which served to regulate its velocity under varying conditions of load. In its original form the governor consisted of "two balls attached to pendulum rods swinging on opposite sides of a shaft. They were kept down by their own weight or by a spring, and they are swung up by centrifugal action dependent on the angular velocity of the shaft." In this manner the speed of the engine was either slowed down or speeded up by the movement of the balls. He stated that it was important that this was negative feedback because it opposed what the system was already doing. He contended that man operates with the same negative feedback while performing voluntary activity; for, the information fed back to the control centers tend to regulate by some measure the amount of movement necessary to accomplish an act, thereby stabilizing the movement of the body.

In support of this theory, Guyton stated that essentially all the control systems of the body were regulated by one common characteristic—that of negative feedback.

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65 Ibid., pp. 95-115.

Smith and Smith succinctly described the difference between these theories by stating:

However, all feedback effects have this important characteristic in common—they are related systematically to the reference response. In this sense, feedback differs from reinforcement, which need bear no relationship to the response it reinforces. Rather, a reinforcement is related to the drive which it reduces or the motive which it satisfies. 67

Lumsdaine attempted to describe the difficulties encountered when trying to implement theoretically optimum conditions into the learning situation. He believed the feedback mechanism was greatly enhanced by intelligent use of cueing devices. Essentially he suggests making the initial cues adequate to bring about the desired response and then tapering off or withdrawing the cue as learning progresses. 68

According to Jokl:

Every voluntary activity productive of patterned work can be analyzed in four stages.

First, in respect of the idea of the work to be performed. Second, with a view to the design of the work as imagined at the moment when the activity begins. Third, in terms of the fact that a constructive plan must encompass the partial activities leading in appropriate sequence to the completion of the task.

67 Karl U. Smith and Margaret Foltz Smith, op. cit., p. 208.

Fourth, with regard to the motor technique employed for the attainment of the objective.69

Walters cited Miller et al. (1960), who claim that in order to produce a skilled action it is imperative that the individual experience the motor response necessary to accomplish it. They believe the subject obtains insight into what movement is necessary by non-verbal guidance and demonstrations and through a trial and error process to determine the sensory cues that are necessary for the acquisition of that skill. They state, "This is accomplished by means of feedback and the skilled act precedes hierarchically into 'action units with more than one level of complexity' and is not simply a chain of reflexes."70

In a further elaboration Robb stated the beginner has a difficult time making a moment to moment self-analysis relationship of his movement pattern and the form he is attempting to achieve. She believes that in order to produce a more effective output the effectors monitoring the performance must have the proper monitored impulse sent back to the central nervous system and that this combined with other coordinated


information is what leads to a more effective skill.\textsuperscript{71}

The idea that the control of stimuli is maintained by a feedback mechanism was reported by Lawther. He believes that in order for the learner to progress most rapidly in the acquisition of a skill he should obtain a prompt and precise knowledge of correct results; for this "feedback is essential for successful modification of response and, therefore, progression."\textsuperscript{72}

Baker and Young believe the learning of simple motor skills is a dichotomous phenomenon. They found the early training periods involve learning only the approximate limitation of the type of response required, and the learner then makes gross adjustments in the appropriate direction to compensate for the constant error cue.\textsuperscript{73}

Smith and Smith, in discussing the complexity of perceptual motor integration feedback, realize there is a very subtle relationship influencing the accuracy of spatial control. They determined the fallacy of

\textsuperscript{71}Margaret Robb, "Feedback," \textit{Quest}, Monograph VI (Spring Issue, May, 1960), p. 42.


believing only gross discrepancies existed between perception and movement. They continued with analysis of the problems encountered by the human engineering field when they attempted to have a human operator reproduce the spatial pattern of his perceived environment.\textsuperscript{74}

The complexity of an analysis of the feedback mechanism is simplified by Alter and Silverman. They believe, in many instances, the feedback for the correct response is of minor importance; however, the function of the response is perhaps only to insure attention.\textsuperscript{75}

The literature is replete with information concerning the desired length of time necessary for maximum effectiveness of the knowledge of results. Brachwill et al. found that short delays between the task and feedback not only failed to interfere with the learning but actually helped improve the retention of the task. However, they cautioned against using intervals encompassing a full day; for they found this did not facilitate learning.\textsuperscript{76}

\textsuperscript{74}Karl U. Smith and William M. Smith, \textit{op cit.}, p. 57.


Bilodeau and Bilodeau discovered that a delay in the knowledge of results did not matter, since the important factor seemed to be the intertrial interval; for they found wide variations in the time of the intertrial interval made the planned response suffer.77

Holland thought it would be possible to measure the strength of providing the knowledge of correct results by taking an observed response and with the knowledge of correct results measure the rate at which the observed response occurred.78

Bourne and his associate also found there was little or no effect on performance when there was a short unfilled delay interval between the response and informative feedback.79 Kintsch and McCoy, in a further elaboration of delaying feedback, did not believe a short delay had any effect upon human performance.80


When the complexity of the skill increased, Fitts found responses were influenced by the proprioceptive and kinesthetic stimulation that had preceded the response. He believed the individual who was engaged in attempting a skilled performance utilized a closed loop feedback mechanism; therefore, the internal feedback loop was as important as the external cue. He continued by saying:

Skilled performance exhibits the three following characteristics: (a) spatial temporal patterning, (b) continuous interaction of response processes with input and feedback processes, and (c) learning. This is a broad definition indeed, one which encompasses a large part of all human behavior.81

In an investigation conducted by Harrison reviewing the basis for motor learning, she believed the learner found the appropriate cue using the trial and error method, and, in this manner, accomplished the desired response. She continued by saying the awareness of sensory cues came because cerebration came early in the learning of a motor skill.82

Van Wagenen and Travers, in a research study of the feedback mechanism, concluded the learner did not


show a marked decrease in performance when sufficient feedback was provided. They believed this seemed to indicate the importance of feedback was primarily concerned with the attention factor that may be involved.  

Travers provides a thought provoking review of the research concerning changes in learning brought about by feedback. He believes when learning a motor skill the individual masters the skill by acquiring a feel for the movement. The subject accomplishes this through mastering the sequence and correctness of each of the integrated parts leading to a skilled performance. When the desired response feels incorrect, the feedback indicates a faulty movement and correction is made immediately and instantly. He continues by saying:

It is as if knowledge of results were built into the performance. Feedback is an indication of sophisticated skill execution because it requires a thorough knowledge of the act and its movements before a person can respond to the change stimuli we have designated as feedback.  

Wulff and Emerson, in a study concerned with teaching and learning, believed it was imperative that a strategy be developed by the teacher to enhance

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the learning process effectively. They state:

Briefly, the strategy is based on recognition of the fact that a training situation must have two characteristics: (1) it must provide opportunity for the learner to make correct responses to relevant cues; and (2) it must provide training conditions that will foster the processes of change that must take place during learning. To apply the strategy, opportunity for practice of correct responses to relevant cues must be provided as defined by the criterion performance. Over and above this, one must identify the initial performance capability of trainees, and determine by analysis what learning processes are required to carry a learner from his initial capability to the final performance required. Finally, training conditions that will foster each of the identified learning processes must be selected and arranged in an appropriate order to provide for maximum training efficiency. 85

REINFORCEMENT

The idea that a behavior pattern can be strengthened or weakened by reward or punishment has occupied the minds of educational psychologists since the time of Thorndike. 86

Pressey et al. reported that educators generally are in line with the pioneer work of Thorndike; for he believed that schools should use as much reward as possible. They continued with an analysis of the effects


86 Edward L. Thorndike, op. cit., p. 111.
of reward and punishment and stated the learner is more likely to respond to environmental stimuli in which past experience has taught him lead to satisfying results rather than to stimuli that has not provided him with such results.  

Bugelski stated that it would be difficult to defend or verify the principle of reinforcement for very obvious reasons. He believes that learning increments cannot be observed but only inferred and that it would be impossible to do this until we can identify the drive stimuli and show that learning occurs as the drive is reduced or diminished.

There is, however, ample evidence to support the reinforcement theory; Spence stated the principle may be formulated in strictly empirical form because any response that is "accompanied or followed by certain kinds of events (called reinforcers) are more likely to occur on subsequent occasions, whereas responses not followed by this class of events subsequently showed a lessened probability of occurrence."  


Cratty discussed the three levels of perceptual motor behavior and, in doing so, supported the reinforcement theory. He stated that "ability traits, in turn, are changed if the individual continues to practice activities which enhance the attributes or begins to avoid activities which result in diminution of certain movement capacities."90

Chansky found that a skill was acquired much faster if continuous reinforcement was provided while the subjects were performing. He favored this type of reinforcement over intermittent reinforcement.91

Melaragno attempted to judge the effects of negative reinforcement in an automated teaching setting and discovered that any given student must not receive too many instances of negative reinforcement, especially if they followed one after another. He stated that the student progressed faster when he was allowed to start with easier instructional skills.92


Additional support was found for this theory from Young. He stated that:

Development through exercise is universally defined as learning but most psychologists think of reinforcement as something different from the increase of habit strength through exercise. Reinforcement is a motivational phenomenon. It relates to the organization and development of neurobehavioral patterns through processes other than exercise.93

Kimble gives a general orientation of the reinforcement theory by stating it pertains to any set of conditions that favor learning. He believed that it was essential to learning because in instances where the act was not reinforced the practice session only produced fatigue and extinction of the learning process. However, he stated that changes in behavior were performance phenomena; and, a precise definition of the learning process was impossible, because there is evidence that learning can occur without an overt motor response. 94

Champion and McBride disagree with studies that make analogies between human and animal subjects, particularly when the theory of informative feedback and reinforcement is discussed. They believe that a comparison of animal and human learning may be misleading, because the delay of reinforcement for an activity had


a very detrimental effect in a very simple learning situation with human subjects.95

The proponents of the reinforcement theories, such as Skinner, assert that such events as curiosity, exploration, and perception are motivated by certain drives that are satisfied by behavior. Thus, an animal may be reinforced by an exploratory activity carried on by itself. In discussing how often an individual needs to be reinforced, he concluded the more often the better.96

Festinger gave additional support to the reinforcement theorists' belief that individuals are motivated by specific drives that lead to reinforcement. He proposed a number of hypotheses about the social comparison process. The first two are applicable to this discussion:

Hypothesis I: There exists, in the human organism, a drive to evaluate his opinions and his abilities.97

Hypothesis II: To the extent that objective, non social means are not available, people


evaluate their opinions and abilities by comparison respectively with the opinions and abilities of others.\textsuperscript{98}

Skinner provided additional support for his theories in another research study. He found that the schedule on which the reinforcement is received is often times much more important than the quantity and nature of it. He believed, in many instances, the organism passes through intervening contingencies; and, therefore, the reinforcing event might not have an effect because the organism did not reach the event scheduled. He continued by stating that it is better to reinforce more often at the beginning of the learning phase; as the subject progresses through the work, he suggested decreasing the reinforcement. He stated that the initial reinforcement occur until the desired behavior pattern was well developed at each stage, thereby gaining more control over the desired response.\textsuperscript{99}

Cook objected to the conclusions that Skinner and his associates gleaned from his work with animals. He did not believe that it was possible for the psychologists to relate the learning curves of animals with humans. In his study he used paired tasks and showed the student the correct answer before the student made

\textsuperscript{98}\textit{Ibid.}, p. 118.

a response. In his concluding remarks he said, "This finding is in direct opposition to what I take to be the current belief of Skinnerians—that a student will not learn merely by being guided through a performance. He will learn; in fact, he will learn faster." 100

Pressey also believed it was impossible to relate animal and human learning, and he particularly objected to the research of Skinner while using pigeons. He also objected to rote reinforcing because the machines that were developed to utilize the response program material theory were insufficient and because he believed that auto-instruction could be learning producing provided it did not lead to rote learning. 101

There is mounting evidence to support the existence of the reinforcement theories. Clayton and Kelleher exemplify an important trend in learning theorizing. The former stated, "Commonly, the term 'reinforcement' is used to connote summing up, a further confirmation of something already known. In this common sense, a reinforcement makes something stronger or increases the strength of an existing structure." 102


The latter discovered that repeated stimuli presented in conjunction with its reinforcer made the stimulus become a conditioned reinforcer.103

Bigge stated it was imperative the instructor make provisions for including reinforcement efficiently if he wished progress in a desired behavior. He believed two considerations should be made; "...gradual elaboration of extremely complex patterns of behavior, and maintenance of the behavior in strength at each stage."104

Deese and Hulse discussed the delay of reinforcement when attempting to teach a skilled perceptual-motor activity and they stated:

The symbolic processes in man should enable him to bridge anything but a very long delay between the occurrence of some response and the information which was the consequence of the response. Certainly, we would not expect a few seconds and perhaps even a few minutes to make much difference in perceptual-motor performance.105


104Morris L. Bigge, op cit., p. 137.

Finally, Smith and Smith, in a summary of the reinforcement theorists' research, stated:

The concept of reinforcement as a basic determinant of learning is indicated both by Thorndike's law of effect and Jull's drive-reduction theory, but was emphasized more explicitly by Skinner's studies of operant conditioning. The instrumental learning situation in which responses produce specific reinforcements has been widely used to analyze the effects of different schedules of reinforcements and other variables on rate of response, rate of learning, and rate of extinction. The results have been extended to interpretations of all human learning, and serve as a theoretical basis for automated teaching-machine instruction.106

MOTOR SKILLS

Historically, research on motor skills has tended to deal with a wide range of specific motor performance. In 1961, Bilodeau and Bilodeau compiled a review of research in this area extending over a period of years from 1945-1959. They stated, "With everyone else, we think task areas are largely a convenience, and it is thus not worthwhile to labor a definition of motor skills."107 They did not believe in different aspects of learning; for they felt learning was learning

106 Karl U. Smith and Margaret Foltz Smith, op cit., p. 47.

regardless of the apparatus or subjects used. They also thought that a separation of research into convenient categories may have refined learning research to the extent that the research lying in between the areas were overlooked. They also say there is a need for including the information human factors engineers gleaned from their research with the psychology studies about motor skills. In their concluding remarks they stated recent years had brought considerable progress and some favorable developments; however, they could foresee additional research in "... feedback, memory, intratask composition rules, reviews and theories, application of skills techniques in clinical psychology."108

Fleishman and Hemple investigated the effects of increasing the difficulty of certain psychomotor tasks. They believed it was conceivable that there were different ability factors causing individual differences between the beginning and advanced stages of skill development.109

Hilgard discovered practice was effective in learning and would not lead to improvement unless

108 Ibid., p. 269.

provisions were made to permit other factors to be effective. He did not believe mere repetition of an act would lead to an improvement in the performance of a simple motor skill.\textsuperscript{110}

Bugelski believed the major error made in the study of motor skills was the lack of research in the pure area of motor learning. He did not believe the laboratory exercises involving maze learning or teaching could be regarded as a motor task. Because of the verbal component that is found in the teaching of a motor skill, he suggested a study of pure motor behavior was almost an impossibility.\textsuperscript{111}

Gagné and Fleishman provide a keystone to the learning process when they state:

As we have seen, most motor skills are to some degree externally controlled. The importance of external stimuli in learning the skill can be observed by introducing changes in the external stimuli which are connected to all or some part of the response-sequence. Much of the time spent in initial learning of skills is a trial-and-error process in which the response-sequence, after many false starts, becomes connected with the "correct" stimuli. From the many stimuli which constantly bombard the learner who is trying to acquire a skill, the ones which form habitual connections are often "discovered" through such trial and error. If we want to speed up this initial learning process, we may


\textsuperscript{111}B. R. Bugelski, \textit{op cit.}, p. 315.
reduce the number of possible "false" stimuli, and thus reduce the time required for discovery of the correct ones. This is often called "guidance" of a skill.

The guidance of initial learning of a skill may be done in various ways. The situation in which the learner is placed can be, and often is, made as free as possible of stimuli which are "false." . . . Another way to guide learning is to direct the learner's attention to "correct" stimuli. . . . Each of these types of guidance accomplishes the important purpose of reducing the time of discovery of correct stimuli, and thus speeds up the total process of skill-learning.112

Halverson succinctly described the needed areas of research in the motor skills area. She believed it would be necessary to combine various areas of research; such as, motor learning perception and neurophysiology, in order to obtain useful information for increasing the individual's ability to learn motor skills.113

Mowrer reported there was ample evidence to support the belief in the athletic prodigy. He stated they had the ability to discriminate between a poor or good performance. He believed there were congenitally determined factors that were essential for the attainment of an unusual skill. He also stated that unless and individual was gifted with this unusual perceptiveness


and sensitivity they would be unable to accomplish an unusual motor skill.\textsuperscript{114}

Broer discussed the necessary prerequisites for obtaining efficiency in movement and in conclusion stated:

While body size, shape, strength, and so forth, are factors in the determination of the success attainable in physical performance, the degree to which an individual can approach his potential depends upon the way in which he uses his physical, mental, and emotional equipment.\textsuperscript{115}

Miller \textit{et al.} contend the individual must be able to experience the motor response necessary to produce the skilled action. This is usually worked out through non-verbal guidance and demonstrations and the learner eventually discovers little tricks to connect the successive parts into a controlled skill. They continue by saying:

There is a kind of complementarity between the teacher and the student. It is easy for the teacher to describe the general strategy, but difficult for him to communicate the detailed tactics that should be used. For the student, on the other hand, each of the muscular movements involved can be made in isolation, but it is difficult for him to combine those tactical details into a larger motor unit.


into a feedback mechanism that will effortlessly guide his movements to reduce the differences between his intended and his actual performance.\textsuperscript{116}

Mowrer discussed motor learning and stated he believed a certain form of sensory acuity was necessary to become adept in a motor skill. He thought there were other factors; such as, kinesthesia, sight, touch, and knowledge involved in the learning of a movement. He stated:

Many skills call for unusual, not to say prodigious, muscular development; but fitness and strength of muscle is not what we mean by learning—though "fitness" is admittedly an essential aspect of many skills. The learning aspect of the problem has to do with the coordination and delicacy of the control which the individual has over his musculature.\textsuperscript{117}

Extensive programs in motor-skills learning began after World War II. The cause appeared to be the result of a familiarity with various apparatus developed for training select air crews for the United States Air Force. Gagné studied the effect of simple practice on a gunnery task and found it is not a particularly effective training method. He also decided that


practicing a performance was not the most efficient way to learn. He concluded by saying:

Here are the psychological principles that seem to me to be useful in training:

1. Any human task may be analyzed into a set of component tasks which are quite distinct from each other in terms of the experimental operations needed to produce them.

2. These task components are mediators of the final task performance; that is, their presence insures positive transfer to a final performance and their absence reduces such transfer to near zero.

3. The basic principles of training design consist of: (a) identifying the component tasks of a final performance, (b) insuring that each of these component tasks is fully achieved, and (c) arranging the total learning situation in a sequence which will insure optimal mediational effects from one component to another.118

Krumboltz and Weisman discovered it was more important to rely on an overt response; however, covert responses aided in the subject's retention of the skill.119 Green also studied overt responses and found it was important for the student to make an overt response while using a teaching machine. In this manner the student was provided with the necessary immediate


feedback that is so important in skill learning. Eigen and Margulies also substantiated this opinion; however, they concluded, "The further the material is from the repertoire of the student, the more important is the requirement of an overt response." However, Holland found overt responding was only helpful if the response was relevant to what was being learned. He concluded by saying, "In fact, irrelevant responses can interfere with learning."

Bugelski offers a practical suggestion:

Before attempting to teach anything, analyze the content or skill to find out what the components are. Then test for the components to be sure they are available. Don't teach a higher level operation without the lower-level equipment or background.

Hively detected a methodological difficulty with many studies when he demonstrated that aversive effects are obtained when the task program extends over too long

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a period. Also, he gained a more consistent performance from his subjects by providing them with additional motivational devices. He suggested the subjects proceed at their own rate in learning a skill, because making a subject repeat a task he had already mastered led to "educational lock-step."124

Stats and Butterfield found that learning could be enhanced by providing the student motivational devices such as tokens. When they discovered a lag in interest in school work they provided the student with small payments for the work achieved and discovered they could stimulate them to perform better.125

Cofer and Appley state:

Reward objects vary in their effectiveness as reinforcers for learning or as instigators of performance, and changes in reward, including their introduction and their omission, often have marked effects on behavior. Small amounts of reward given before a performance may instigate vigorous or rapid performance, despite the reduction such prerewards must induce in the deprivation state.126


They concluded there was an increase in vigorous and rapid performance when incentives were given.127

Fleishman discovered there were no general attributes which could be termed athletic ability. He suggested there could be certain basic components such as limb flexibility which would assist the individual in attaining a certain level of motor skill. He discounted the term explosive power; for, he found it was more than a simple ability. Therefore, he preferred the term energy mobilization.128

Michael and Maccoby believed that learning took place faster after the student was provided with a knowledge of correct results. They discovered the subjects attained a superior level of learning with both manual and verbal activities when they were "... given the opportunity to rectify an error by knowing that an error had been made, what the error was, and what the correct behavior should be..."129 They found ample research

127 Ibid.
evidence to support their claims from previous experimentation in other media.\textsuperscript{130}

Alter, in discussing intelligence as a function of learning, discovered it to be a significant factor; however, the amount of training time was not related to learning or retention.\textsuperscript{131}

Glaser, reviewing fifteen years of research, found many of the leading psychologists did not rely on the well known principles of learning but analyzed each task or motor skill into component parts developing techniques of task analysis and sequencing. He stated, "Once a complex task is analyzed into component tasks, the question arises about the characteristics of certain subtask arrangements which can facilitate learning."\textsuperscript{132}

Travers et al. found the subjects who interacted with the experimenter performed better. They believed this was caused by a greater level of arousal which,

\textsuperscript{130} Ibid., pp. 271-294.

\textsuperscript{131}Millicent Alter, "Retention as a Function of Length of Retention Interval, Intelligence and Training Time," Journal of Programmed Instruction, Vol. II, No. 2 (Summer, 1963), pp. 7-17.

in turn, influenced the acquisition of a skill. \(^{133}\)

Adams, continuing the motor skills review in 1964, suggested the need for research in the area of anticipatory timing. He pointed out that the timing for skills was probably the most important aspect in the learning of a motor skill and that greater emphasis in this sector would give greater insight into understanding the mechanism behind the learning of a skill. \(^{134}\)

Travers believed the most neglected and under-rated learning was that of motor learning. He thought success in writing, speaking, and reading depended upon some skill of bodily movement and that "... verbal learning seems to flow from motor learning..." and the principles and characteristics of both are identical. \(^{135}\) He continued by saying he believed:

Before anyone attempts instruction in a motor skill, he should be thoroughly expert in its performance. He must understand all the details of the whole; he must understand the correct form for performing the task; he must also appreciate the individual differences which each person brings to the task. Such competence is the one norm which never can be excluded.

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\(^{135}\) John F. Travers, *op cit.*, p. 73.
Without this proficiency, an instructor is unable to analyze the act into its parts and to present these parts, always in relation to the whole, as an intelligent sequence to a class. If an instructor does possess this adequacy, he is sufficiently familiar with the task to describe it to the class, to demonstrate it for the class, and to guide the class (as a class and as individuals) through its first crude efforts and to adjust the task to individual variations.

Verbal instruction is an essential part of motor learning, and, as such, it should achieve a definite purpose. The goal of verbal instruction is understanding so that, primarily, learners may comprehend why they are learning a particular task, and, secondarily, they may apprehend the parts and their relation to the whole.

Such verbal instruction will help to stimulate motivation because through verbal instruction the instructor enables the students to realize the value of the task. Motivation is usually not a problem in motor learning because knowledge of results is instantly obtained. The chief danger is the use of verbal instruction during the introduction of a motor skill is that the teacher may include excessive facts and thus confuse students.

When the instructor thinks that the learner understands the vital relationships of the task, he may show how it is to be done. Pictures, diagrams, movies, models, or whatever is deemed effective should be used. These tools should emphasize the form of the skill and should be presented with continued verbal instruction to reinforce understanding. Here, the learner actually sees what the correct form is, that is, how the expert performs his task. But demonstration can only be used to increase comprehension, to grasp the total act, or to enhance the learner's perception of the part-whole relationship.136

136 Ibid., pp. 87-88.
An intriguing study by Jones seemed to indicate the only essential necessary in the learning of a gross body skill was the development of a kinesthetic image. He believed it was necessary for the student to receive and interpret given information in order to form this image which he found aided and promoted the learning of a motor skill.137

Hebb believed offering small segments of a learning task tended to be inefficient; however, he contended too big a task often discouraged the student. He found it was possible to obtain the best results by offering the total unit to be learned, then separating the skill into smaller segments eventually offering the larger one.138

Hall contended the learning process is not always clear because we have not been able to control all of the variables or determine which ones made the primary contribution. He believed it was possible to ferret out these variables if the researcher would attempt to study the simple tasks learned by man. In this manner, he believed the simple tasks would give


138 Donald Olding Hebb, op cit., p. 135.
insight which would allow generalizations about the more complicated tasks. 139

Ausubel believes the principles of learning take place only when the teacher presents the component concepts in such a manner that they can be readily recallable; and, then the instruction for additional learning must be presented to the learner indicating the correct sequence of these components. He believed the instructor should present introductory material or "organizers" that were appropriate, maximally clear and stable. He continued by saying:

These organizers are introduced in advance of the learning material itself, and are also presented at a higher level of abstraction, generality, and inclusiveness; and since the substantive content of a given organizer or series of organizers is selected on the basis of their appropriateness for explaining and integrating the material they precede, this strategy simultaneously satisfied the substantive as well as the programming criteria for enhancing the positive transfer value of existing cognitive structure on new meaningful reception learning. 140

McDonald stated that a skilled performance was observable; therefore, the manipulative aspects could be


demonstrated. He continued by stating, "An important variable affecting the facility with which a skilled behavior is acquired is the amount of guidance provided in the learning experience." 141

He believed the methods of instruction should be given to provide an insight into the type of response that is expected. However, he cautioned the learner must attempt the skill in order to be able to master it. He then said:

Therefore, the films, filmstrips, and slides frequently used to demonstrate skilled behavior—although they have the advantage of presenting a demonstration to large numbers of students at the same time—have certain limitations. In the first place, if the film attempts to teach too much, the student will receive more information than he can assimilate. Second, the film may provide so much guidance at one time that the student does not have adequate opportunity to attempt the responses on his own. Third, since the movie observer usually is limited to a verbal and imaginative rehearsal of what is to be done, the film may not require him to attempt the response actively and physically. Generally speaking, a demonstration method that requires the student to participate actively will be superior to a method that requires less active participation. 142

Bergman discovered two factors involved in learning. He believed that performance was based on a negative function of forgetting what had been learned in the past and the positive function of the individual


142 Ibid., p. 399.
attempting to retain all that had been learned. He believed this could be built up by training and the growth of resistance to forgetting is proportional to the interference encountered between trials.\textsuperscript{143}

Anderson stated:

There is quite a variety of approaches to the organization and sequence of introduction for which a plausible argument could be made. . . . One general point seems quite clear. The kind of sequence that will produce the best results will certainly depend on the characteristics of the task. It will make a difference, for instance, whether the task requires a chain of behavior or whether, on the other hand, a series of discrete responses must be associated with a series of discrete stimuli.\textsuperscript{144}

Lockhart succinctly summed up the problems existing in learning when she stated, "... those who would understand learning of any sort must remember that so far as is presently known the ingredients of learning are intricate, multidimensional, delicately integrated and basically inseparable."\textsuperscript{145}


\textsuperscript{145} Aileene Lockhart, "What's in a Name," Quest, Monograph II (Spring Issue, April, 1964), p. 13.
Summary

An examination of the history of the use of teaching machines in education reveals there is general agreement among learning theorists that the utilization of these machines can offer a more effective and meaningful method of presenting structural material, thereby greatly enhancing the learning process. There is common agreement that strength and stability of learned responses depend on the occurrence of feedback with provisions made for a reinforcing event following this response. Also, ample research evidence indicates the immediacy of the feedback and reinforcement cannot be judged by interspecies interpretations, because man has the ability to retain a mental picture of his response, thereby bridging the time gap between the response and learning the consequence of this response. In fact, research indicates, unlike animals, the human is able to withstand a time lapse of many minutes; viewed scientifically, man possesses a behavior system that has a function of input, transmission, output, and energizing with an additional ability of retaining a memory pattern of each action.

Evidence indicates the early use of instructional television suffered because of man's inability to utilize the instrument effectively. The early presentations were filmed lectures offered to the learner in much the same
manner as before. However, with the invention of immediate videotape replay, this media offers one additional and necessary educational aspect to the learner; a provision for viewing the results of his performance immediately, thereby including the integration of the one important phase missing in other machines. Videotape replay instruction can be devised to incorporate feedback in the form of knowledge of correct results and provide immediate reinforcement. It has the advantage of immediate reinforcement, reinforcement after every response, assurance of active participation, adaptability to individual capabilities, and a means of focusing the attention of the student upon a small visual area, thereby decreasing the effect of extraneous factors which surely must detract from the learning process.

It optimizes feedback control of knowledge and skills by offering dynamic feedback analysis which is most important in cognition. Research evidence indicates it is able to offer transformation of the primary sensory properties of feedback but retain the basic reactive organization of overt behavior. It is generally agreed it insures a high level of response by providing many cues and prompts essential during early learning.

There is ample evidence that behavior is energized by motivation. Research evidence indicates this electronic tool provides that aspect of learning which
allows the student to focus his attention upon the way he interacts with his environment. By these means he is provided with an internal self-regulation mechanism which enables him to restore a state of equilibrium with his environment. It also provides an integration of other visual material which gives additional flexibility to the learning process.

Since motor skills are specialized in learning and memory by their feedback control mechanism because they reflect a perceptual specialization and organization that is derived from their sensorimotor regulation, it appears television videotape instant replay can contribute significantly to the learning of it. The individual is provided with an instrument whereby he can record, review, respond, refine, and redo psychomotor performance.
METHODS AND MATERIALS

The rapid growth of educational technology has initiated a series of changes in most every discipline from the primary school through the university. Industrial and military educational curricula have made educators realize that active, well planned research can lead to new methods of instruction. Investigations made in military, industrial, and educational instructional areas indicate that each is actively engaged in the spirit of change with one or the other of these programs sometimes leading, sometimes following.

In the past few years, the use of teaching machines and/or aids represents methods of instruction that have attracted a considerable amount of interest. Although they have initiated many educational changes that have been given the name of "new methods of instruction," for the most part, these programs usually consist of a collection of psychologically sound teaching principles that have been known for some time. Actually, their unique characteristics are found in their coordinated application of these principles which have provided new insight into the teaching and learning process.
The present study is an analysis of one of these methods upon the educative process. An attempt will be made to determine whether or not greater efficiency and rapidity of learning is obtained by using a videotape recorder.

Although television as an educational media is relatively new, the quantity of research revealed that in the present use of the electronic tool there was little-significant difference between traditional instructional methods and educational television as now frequently used. However, with the recent reduction in cost of videotape instant replay, evidence seems to indicate that this method "bridges the gulf between the anonymous world of mass communication and the intimacy of teaching an individual."\textsuperscript{1}

An examination of the related literature seems to indicate this recent innovation will provide the necessary overlap between the two aforementioned methods of instruction that will solidify their unstable relationship. Also, this instrument gives educators a means of providing immediate feedback, knowledge of correct results, and reinforcement of a desired response. This is of the utmost importance to physical educators because practice, that is, repetition of the desired response sequence with reinforcement is of the

\textsuperscript{1}Henry R. Cassirer, \textit{op cit.}, p. 162.
greatest importance in the acquisition of motor skills.\textsuperscript{2}

Finney reported the design of an experiment can be improved by dividing the subjects into pairs so that the members of each pair are as alike as possible and then to assign one from each pair to each treatment. He also stated that the selection from each of the pairs must be made at random and independent of all other pairs; for, pairing succeeds in bringing together subjects that are alike, improving the experiment.\textsuperscript{3}

Fisher also stated, "Uniformity is the only requisite between subjects whose response is to be contrasted or subjects that are to be treated differently."\textsuperscript{4}

Therefore, for this study the students were divided into two matched groups. The data collected prior to the experiment for use in pairing were height, weight, chronological age, somatotype classification, intelligence, and motor educability using the Iowa Brace test.

Complete sets of data representing these variables were collected for 199 eighth and ninth grade boys attending physical education classes at Lincoln Junior

\textsuperscript{2}Robert M. Gagné and E. A. Fleishman, \textit{op cit.}, p. 394.


High School, Fort Collins, Colorado. By matching each variable as closely as possible, fifty-five pairs of students were selected.

The collection of data was accomplished in the following manner:

1. Height (inches) and weight (pounds) measurements were obtained from administrative records maintained by the physical education instructor.

2. The age of the student (months) was computed from the date of birth provided by the student.

3. The student was given a somatotype rating based on W. H. Sheldon's theory that the human physique is composed of a mixture of three components; endomorphy, ectomorphy, and mesomorphy. Each of the three components is rated on a seven point scale, the higher rating indicating predominance. Thus, a predominantly endomorph would be a 7-1-1, a mesomorph 1-7-1, and an ectomorph a 1-1-7. The sum does not always add up to nine; an average individual representing no extreme body type would be a 3-4-3 or 4-3-4. This is continually provided for with a plan in which an extreme type may be avoided.

4. Intelligence quotient, using California Mental Maturity Verbal and Non-Verbal Test scores, was obtained from the student personnel records maintained.

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in the school administrative offices. Scores obtained were from group tests previously administered as part of the regular school program.

5. The scores representing motor educability were obtained by administration of the Iowa Revision of the Brace Motor Ability Test which consisted of ten stunts designated for junior high school students in grades seven to nine. The test was administered using the suggested group testing procedures.

6. Students were screened to determine previous experience on the gymnastic parallel bars. Anyone having experience was eliminated from the study.

To determine if the two instructional groups were essentially equal, the mean and standard deviation were computed for each of the matching variables. Separate computations were made for the conventional group, experimental group, and the total group, which consisted of all students having a complete set of data. The results of the statistical computations are shown in Table 1.

Comparison, by variable, of each mean and standard deviation between the conventional and experimental groups with that of the total group revealed that the means were nearly equal and the standard deviations exhibited normal variability. The small amount of scatter was the result

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of a more narrow frequency distribution in the paired groups caused by the removal of variable extremes during the matching process. The total group, on the other hand, contained all the scores for each variable; therefore, a wider frequency distribution and a larger standard deviation resulted. Exceptions to this condition were the nearly equal standard deviations for height and the somatotype classification, which could be explained by the nearly equal measurements occurring naturally within the age group.

### TABLE 1

**MEAN AND STANDARD DEVIATION, BY MATCHING VARIABLES, FOR THE PAIRED GROUPS AND THE TOTAL GROUP**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group I</th>
<th></th>
<th>Group II</th>
<th></th>
<th>Total Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>S.D.</td>
<td>X</td>
<td>S.D.</td>
<td>X</td>
<td>S.D.</td>
</tr>
<tr>
<td>Height</td>
<td>63.53</td>
<td>3.27</td>
<td>63.67</td>
<td>3.24</td>
<td>63.62</td>
<td>3.54</td>
</tr>
<tr>
<td>Weight</td>
<td>113.31</td>
<td>21.07</td>
<td>113.45</td>
<td>20.93</td>
<td>114.70</td>
<td>24.20</td>
</tr>
<tr>
<td>I. Q.</td>
<td>104.45</td>
<td>13.17</td>
<td>103.80</td>
<td>12.70</td>
<td>105.00</td>
<td>15.40</td>
</tr>
<tr>
<td>Motor Educability</td>
<td>13.47</td>
<td>2.57</td>
<td>13.31</td>
<td>2.80</td>
<td>13.16</td>
<td>3.34</td>
</tr>
<tr>
<td>Age</td>
<td>169.70</td>
<td>8.64</td>
<td>170.86</td>
<td>9.36</td>
<td>170.51</td>
<td>11.83</td>
</tr>
<tr>
<td>Somatotype</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endomorph</td>
<td>2.05</td>
<td>0.87</td>
<td>2.07</td>
<td>0.79</td>
<td>2.05</td>
<td>0.98</td>
</tr>
<tr>
<td>Mesomorph</td>
<td>3.24</td>
<td>0.77</td>
<td>3.15</td>
<td>0.85</td>
<td>3.07</td>
<td>0.81</td>
</tr>
<tr>
<td>Ectomorph</td>
<td>3.12</td>
<td>0.86</td>
<td>3.04</td>
<td>0.80</td>
<td>3.10</td>
<td>1.50</td>
</tr>
</tbody>
</table>
The study was conducted at the Colorado State University Auditorium-Gymnasium complex, utilizing the facilities of the Athletic Department which consisted of:

1. One set of gymnastic parallel bars.
2. Protective foam rubber matting placed under the parallel bars.

The arrangement of the equipment for the experimental method of instruction is shown in Appendix C; the conventional group utilized the same equipment sans television.

The results of the matching process are shown in Appendix A. Subjects from each pair were then randomly assigned by a flip of a coin to conventional and experimental instructional groups.

The design of the data collection card can be found in Appendix B.

After consulting with an instructor knowledgeable in the levels of skill that could be attained by this age group, a select group of gymnastics events was chosen from *A Manual of Heavy Apparatus and Tumbling Stunts* by John A. Scannel. They represent a progression of exercises which had proved successful over a period of many years.

A meeting was arranged with the Colorado State University gymnastic coach and the junior high physical education instructor, at which time those stunts were selected that the students of this age group could accomplish. At this time a decision was made to establish a group of stunts that would lead to a basic gymnastic routine. These included hand travelling, dips at the end of parallel bars, front vault, rear vault, shoulder balance, forward roll, kip from upper arm hang, and front and back uprise.

Prior to the first class a qualified gymnastic instructor with five years of experience was retained. The entire program was reviewed and the basis for selection of the stunts was explained.

A meeting was then arranged and the entire study was explained in detail to the subjects with additional information being sent to the parents. Of the fifty-five pairs selected, approximately thirty-five volunteered to participate.

Arrangements were then made for a meeting of the paired groups. At this time, they were assigned a locker area and given a tour of the entire auditorium-gymnasium complex. The route to and from the gymnasium was covered in order to expedite the proceedings.

Both groups attended the gymnastic sessions twice weekly on Tuesday and Thursday for seven weeks using the
same room and the same gymnastics equipment but at different hours. All sessions began with an explanation of the procedure for that day followed by the demonstration of the instructor of the gymnastic project for the class period. In the conventional class all demonstrations and lectures were presented using the traditional approach. In the experimental class the demonstration and subsequent trials by each subject were presented via videotape replay. The same principles and skills of gymnastics were presented to both groups by the same staff.

During the first class meeting, the subjects were required to learn the proper upper body positioning and arm support to avoid the round shoulder technique; during the entire program, proper body position was stressed.

The method of instruction for both the experimental and conventional groups was the same; however, the experimental group performance was recorded on videotape and then this performance was criticized. The method of instruction was as follows:

1. An explanation and demonstration was made of the stunt to be performed.

2. Then each student, in turn, addressed the parallel bars and attempted the stunt under the guidance and coaching of the instructor and his assistant. During the performance by the experimental group, a videotaped recording was made.
3. At the conclusion of each stunt the subject performed a prescribed dismount. The individuals in the conventional group took their place at the end of the line; the experimental group formed a line facing the television monitor.

4. After the entire group had completed the attempted stunt, the instructor made constructive comments about their performance. When necessary, he re-demonstrated the proper technique. The experimental group, in sequence, addressed the television monitor and viewed the video recording of their performance; at which time, the instructor criticized the performance. The experimental subjects then assumed their starting position behind the parallel bars for the next unit of instruction. At the conclusion of the viewing, the instructor made additional comments and then resumed the instructional cycle.

Each instructional session was forty minutes in length; the experimental group received their instruction at 5:00 P.M. with the conventional group meeting at 6:00 P.M. In order to discount the difference in time and any teaching experience gleaned from the first session, the groups were reversed at the beginning of the fourth week. The conventional group started at 5:00 P.M. and the experimental group met at 6:00 P.M.
The subjects were given a grade of excellent, good, average, fair, poor, or failure for each component of their performance. The grade was determined by the instructor, his assistant, and a judge; the grade was averaged and recorded by the grade recorder. The design of the grade recording sheet can be found in Appendix B.

In the case of absences causing missing data, Winer stated that where the missing observations are small, it is possible that previous information may be used in estimating the missing scores. He also stated it was possible to use a multiple regression equation; however, he claimed this solution was not practical. He suggested that caution and judgement be used with any method selected.\(^8\)

At the first meeting the subjects were told that it was imperative that they attend every session of the experiment. They were asked not to participate in the study if for any reason they believed this would not be possible. However, during the course of the experiment, a small number of subjects missed single sessions because of sickness or other unforeseen problems. A decision was made to eliminate any subject who missed two consecutive sessions. Eight of the paired subjects were eliminated; however, in three instances it was possible to pair them with other subjects.

Prior to the start of the investigation, the junior high instructor and the research team believed the subjects would have a great amount of initial interest with a decline as the experiment progressed. In order to discount the possibility of this effecting the study, the research team decided to provide each subject with a device that would keep his motivation high. During the experiment, the subjects were offered various possibilities; such as, instruction from the Lettermen in their various sports, passes to athletic contests, or swimming instruction. They chose the swimming instruction. One swim permit was issued for every day the subjects were involved in the study. The writer believes this accounted for the high attendance during the experiment. The design of the swim permit can be found in Appendix B.

Additional Equipment

The experimental method of instruction was conducted using the following additional equipment manufactured by the Sony Corporation, Tokyo, Japan.

1. Camera Ensemble VCK-2000. This ensemble consisted of a solid state video camera with an f/1.9, 25 mm, "C" mount lens, tripod, and extension cords.

2. Videocorder Model TCV-2010. This self-contained unit consisted of a videotape recorder and an eight inch monitor.

3. Videotape V-32, one-half inch wide on a seven inch reel with one hour playing time. The tape was erasable and could be used again.
ANALYSIS OF DATA

In a general way, physical educators have known that students may learn more efficiently if conditions are arranged which permit them to practice and then observe themselves in order to actively determine the appropriate response they need to achieve success. Since the students' response and the technique by which their actions may be suitably controlled for effective learning are both of practical and theoretical interest, a decision was made to test the effects of using videotape instant replay in the teaching of a gross motor skill such as gymnastics.

Because of the complexity of the learning phenomena, it is well known that there are many extraneous factors that tend to detract from the ability of a student to learn. However, learning theorists are in general agreement that learning increases progressively when an increasing amount of time is spent in actively responding and when the student is provided with immediate reinforcement during the learning process. Many investigators have indicated the most important aspect of the process is the critical nature of the time interval between the response and the reinforcing event. With the recent progress made in videotape recording, it would seem possible to provide
the student with feedback in a relatively short time interval, thereby giving him an immediate knowledge of correct results.

The proposed research attempted to ascertain the effectiveness of television instant replay in the teaching of selected gymnastic skills and to compare and contrast the degree of this effectiveness with the results of customary gymnastics instruction. Since physical education is a subject in which the visual element has a significant bearing on the quality of the finished skill produced by the student, it is easy to assume that learning lends itself more readily to instruction by television than to verbalized directions. In order to avoid such hasty and unsupportable conclusions, this study will statistically evaluate the effectiveness of immediate videotape replay in teaching a gross motor skill. Still a second aspect of the problem is to determine the comparative effectiveness of the two methods in producing proper execution leading to good form. Also, a comparison will be made of the number in each group who have not completed the selected skills at the end of seven weeks.

Statistical Procedures

These data are expressed in terms of discrete categories which are in contrast with measurement data. This means that the data are recorded in terms of the
number of subjects that fall into two or more categories. Therefore, there is an attempt made to measure "the degree of association which exists between variables for which we have only categorical information." It is apparent that the X^2 method involves finding the discrepancies that exist between the observed and expected frequencies; the observed frequencies are the categorical grades given to the students during the experiment. It is important that many observations be made in order to insure a normal distribution. To insure validity, the categorical data should be such that none of the cells contain frequencies of less than five.

"The distribution of X^2 depends on the number of independent deviates, that is, on the degrees of freedom. For each number of degrees of freedom there is a X^2 distribution." The degrees of freedom do not depend upon the number of subjects that are involved in the experiment.


because the degrees of freedom for this statistical tool are determined by the number of deviations between the observed and expected frequencies. The degrees of freedom are found by determining the cells that are free to vary. This may be determined by taking the number of rows minus one and multiplying this figure by the number of columns minus one. Thus, in this experiment there are two rows and six columns; therefore, the number of degrees of freedom is 5.

Null Hypothesis.—There is no difference between teaching by using immediate videotape replay and the conventional method.

Significance Level.—The hypothesis will be tested at the .01 level.

Sampling Distribution.—Under the null hypothesis, $X^2$ is computed from the following formula:

$$X^2 = \frac{(O_1 - E_1)^2}{E_1} + \frac{(O_2 - E_2)^2}{E_2} + \ldots + \frac{(O_k - E_k)^2}{E_k}$$

$X^2$ is distributed approximately as chi square with $df = (\text{row-1})(\text{column-1}) = (2-1)(6-1) = 5$. The value for 5 degrees of freedom at the .01 level is 15.09.

Rejection Region.—The region of rejection consists of all values of $X^2$ which are so large that the probability associated with their occurrence under the null hypothesis is equal to or less than 0.01.

Determination of Expected Frequencies.—The expected frequencies may be calculated by multiplying the two marginal totals common to a particular cell, defined as the junction of a row and a column, and then dividing this product by $N$ to obtain the expected frequency.

At the conclusion of the study it was possible to pair 27 of the original subjects. The mean and standard deviation of the six variables are found in Table 2.

**TABLE 2**

**MEAN AND STANDARD DEVIATION, BY MATCHING VARIABLES, FOR THE CONVENTIONAL AND THE EXPERIMENTAL GROUPS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Conventional Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{X}$</td>
<td>S.D.</td>
</tr>
<tr>
<td>Height</td>
<td>53.06</td>
<td>2.80</td>
</tr>
<tr>
<td>Weight</td>
<td>116.45</td>
<td>22.80</td>
</tr>
<tr>
<td>I. Q.</td>
<td>107.22</td>
<td>10.52</td>
</tr>
<tr>
<td>Motor Educability</td>
<td>13.77</td>
<td>2.32</td>
</tr>
<tr>
<td>Age in months</td>
<td>168.66</td>
<td>8.37</td>
</tr>
<tr>
<td>Somatotype Classification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endomorph</td>
<td>2.51</td>
<td>1.03</td>
</tr>
<tr>
<td>Mesomorph</td>
<td>3.40</td>
<td>1.02</td>
</tr>
<tr>
<td>Ectomorph</td>
<td>3.18</td>
<td>.78</td>
</tr>
</tbody>
</table>
Comparison, by variable, reveals the means and standard deviation are nearly equal. An examination of the table containing the six variables of the subjects reveals a nearly equal pairing of the students.

Upon the advice of the Statistical Department at Colorado State University, each segment of the skill was graded. This was suggested in order to provide a great deal of sensitivity to the selected statistical tool—chi square. In fact, the entire statistical procedure of the study was guided by a member of the Mathematics and Statistical Department at Colorado State University and one member of the University of Colorado Statistical Department. Additional help was received from the Radiation Biology Research Laboratory at Colorado State University.

### TABLE 3

**COMPARISON OF IMMEDIATE VIDEOTAPE REPLAY AND THE CONVENTIONAL METHOD IN TEACHING A SELECTED GYMNASTIC SKILL**

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Fair</th>
<th>Poor</th>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exper.</td>
<td>60</td>
<td>753</td>
<td>684</td>
<td>342</td>
<td>165</td>
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7Personal interview with Dr. Calvin Butler, Ass'gt Prof., Statistical Dept., Univ. of Colorado, October, 1966.

8Personal interview with John Modrick, Ass'gt Prof., Psychology Dept., Colorado State University, February, 1967.
### TABLE 3 - Continued

**CALCULATION OF EXPECTED VALUES**

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**CALCULATION OF CHI SQUARE**

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**Total** 72.92

**Interpretation of Data.**—An average of the judge's rating of excellent, good, average, fair, poor, and failure was used in the computation of chi square. This sum
exceeded the value of 15.09 for 5 degrees of freedom; moreover, the value is significant beyond the 0.001 level. Since \( p < 0.001 \) is less than the previously set level of significance, 0.01, the null hypothesis was rejected.

In examining the effects of the experiment upon the cell data, it is perhaps appropriate to consider the general effectiveness of television upon the study. In other words, is there sufficient additional evidence to support the finding that the use of this instrument will add to the overall effectiveness of teaching a motor skill? An examination of the data presented in Table 3 revealed the experimental group had received approximately 59 per cent of the excellent grades. It can be seen that the magnitude of the disagreement between the observed and expected frequencies would determine the amount of difference existing between the two methods of teaching. If the agreement between the observed and expected values is close, the differences between them should be small and consequently chi square will be small. If the divergence is large, however, the value of chi square as computed from the formula will also be large. Roughly speaking, the larger the chi square value the more likely it is that the observed frequencies did not come from the population on which the null hypothesis is based. If there had not been a difference between these
two methods of teaching, the expected frequency of excellent values for the cell of the experimental group should have been approximately 40 and the conventional group should have received 62; however, observed excellent scores for the experimental group were 60 while the conventional only acquired 42. This trend continues in the good category. The experimental group was expected to receive approximately 646 of these values and they acquired 753. In contrast, the group using the conventional method of teaching should have obtained approximately 1,017 of the good values and they only received 910. This, in itself, appears to be an indication of the effectiveness of this media.

In continuing the examination of this table, it can be seen that the average, fair, and failure grade differences between the observed and expected values did not significantly effect the chi square total. However, the expected value of the poor category for the experimental and conventional group was approximately 213 and 355, respectively, but the observed was 165 and 383, which revealed a great deal of influence upon the chi square sum.

It should be noted that although the groups did not show a large amount of difference in the average, fair, and failure categories, the results indicate immediate feedback significantly increased the excellent
performances while decreasing the poor performances of the experimental group. This also appears to be another indication of its overall effectiveness.

There appears to be ample evidence that feedback, knowledge of correct results, and reinforcement are of more importance to those individuals who are able to quickly acquire skill. Also, there is an indication that the relevance of feedback is to enable and encourage the beginner to reduce the number of errors, thereby decreasing his poor performances. In this regard, the use of videotape replay is pertinent, since these data imply that the provision for an examination of an individual motor performance not only helped this group achieve a greater number of excellent scores but also assisted them in decreasing the number of poor performances. In addition, the progress of the experimental group allowed them to advance to the more difficult stunts. Moreover, thirteen of the experimental subjects were able to complete the entire basic gymnastic routine with grades of excellent and good, while only seven of the conventional group accomplished this maneuver with the majority of their grades in the good and poor category.
DISCUSSION

An investigation of the early research indicated physical educators and educational psychologists had probed into the mysteries of the learning process utilizing various teaching instruments. Their interest varied from observations of gross motor performance to analysis of learning and its effect upon the acquisition of refined psychomotor skills. Analysis revealed at different times in the history of physical education these combinations and their effect upon the skilled performance have played a more or less prominent role. Nevertheless, this has not been true in the field of educational psychology. Presently, however, the recognition of a lack of dichotomous relationship is dominant in both disciplines. Research indicates that we cannot regard motor learning as a gross type of operation which only comprises a mechanical manipulation of body segments in the accomplishment of some task. This appears to be an oversimplification of a complicated procedure that involves the total individual.

It appears that learning cannot and will not take place in a vacuum because there is a commitment of the
total organism in the acquisition and perfection of a skill. Early studies indicate the student must have the material he can comprehend in order to accomplish the most elementary tasks; for, it is impossible to expect any interaction or change in behavior pattern until the material is meaningful to the subject. Most investigators have indicated the body of the individual is only acting as a medium which receives the stimuli that will, if presented within the framework of the student's reference, ultimately effect the desired changes in his behavior.

Also, past research indicates the environment in which we place the student should be structured to aid in adding additional stimuli in order to provide further assistance to the learning process. Early studies suggest the educator should intelligently plan and arrange the most advantageous milieu in which to assist his students. In addition to the environmental stimuli, the student must be properly motivated. Every effort should be made to increase his perception of what he is to do and what will ultimately be expected of him. After this has been accomplished he should be provided with an immediate knowledge of results so that he may increase the refinement of the response pattern desired. Research evidence seems to indicate that anything faulty in the pathway carrying the preselected stimuli of feedback,
Immediate knowledge of results, and reinforcement will cause the desired educational objectives to be retarded. The unity of the performance cannot incur a loss for it may be extremely difficult if not impossible to recapture.

Such deductions lead to the inevitable conclusion that whatever adversely effects the information presented will affect learning; also, there is ample evidence to support the need for a sequential presentation of the material to be learned.

An appraisal of the many phenomena comprising the learning of a skill seems to suggest a need for combining the known principles with a teaching instrument that would assist in providing those theories deemed most desirable in learning. In every instance research indicated the most important aspects of the learning process were dynamic feedback, immediate knowledge of correct results, and reinforcement. Therefore, careful consideration of the aforementioned evidence seems to indicate videotape instrumentation could assist in providing a solution to the problem. Consequently, these initial experiments suggested a need for the present study: A comparison of videotape replay with a traditional approach in the teaching of selected gymnastic skills.

Data gathered for this study resulted from an investigation of two groups: one of which used the conventional approach in learning a gymnastic skill using
parallel bars, the other group used the same method; however, in addition, immediate videotape replay was provided in an attempt to enhance the learning process by giving feedback and reinforcement in the form of knowledge of correct results.

A null hypothesis or the hypothesis of no difference between the methods of instruction was formulated. The data permitted a rejection of the research hypothesis at the .01 level of significance which indicated support to the research hypothesis and its underlying theory. The chi square value was large enough to indicate that such a value is significant far beyond the 0.001 level. Since \( p < 0.001 \) is less than the previously set level of significance, 0.01, the decision led to rejection of the null hypothesis. Therefore, it was concluded that the use of immediate videotape replay is unrelated or independent of the conventional method; in other words, the evidence seems to indicate a great deal of dependence upon the use of the new media.

An examination of the cell data recording charts revealed the separation between the conventional and experimental groups started to take place at the inclusion of the more advanced gymnastic skills. It would appear from observation the significance of feedback is particularly noticeable where a knowledge of correct body position is of extreme importance. The advancement
of the experimental group began with an introduction of the kip from upper arm hang and the shoulder balance. The most conspicuous gains were made when the subject was asked to place his body or a segment of it into an unfamiliar position. However, with the help of immediate feedback the experimental group could make a more rapid adjustment, thereby completing the skill faster than the conventional group. During the shoulder balance the television group was able to see faulty head position and correct it more rapidly than the conventional group. Also, the experimental group was able to see the necessity of having the buttocks above the bar during the kip from an upper arm hang. When they noted extremely poor position of the buttocks, they easily made corrections which led to the accomplishment of the kip at a more rapid rate.

During the last class period thirteen experimental subjects were able to complete the entire gymnastic routine with the majority of the grades ranging from good to excellent, while only seven of the conventional group could complete this same routine and then with only one excellent grade. The majority of the grades of the conventional group during this routine range from poor to good.

The calculations for chi square reveal the number of entries of how many of the subjects may be expected to fall in each category on the hypothesis of a normal
distribution. The discrepancies of the observed and expected values of the excellent and good and poor cell were large; therefore, they exerted an immense influence upon the chi square value. The magnitude of the difference between the observed and expected frequencies in most cells revealed the amount of difference existing between the conventional method of teaching, which uses verbal instruction, demonstration, practice, and correction with that of this same method aided by a videotape recorder. The large chi square value indicated that the observed frequencies did not come from the population on which the null hypothesis was based.

It is interesting to note that although the experimental group had fewer trials they had a greater number of excellent values and a fewer number of failures. Moreover, the significant gains established in the upper levels of the table appear to support the findings in the Review of Literature; that is, a knowledge of correct results, feedback, and reinforcement appear to be of more significance after the individual has attained a measure of proficiency in a motor skill.

Findings

This study was concerned with teaching a gross motor gymnastic skill using parallel bars. Based upon the results of statistical analysis of the data and
keeping within the limitations imposed by the design of this study, the following conclusion would appear to be justified.

1. The size of the $X^2$ value reflected the magnitude of the discrepancies between the observed and expected values in most of the cells revealing a value beyond the 0.001 level. Since $p < 0.001$ is less than the previously set level of significance of 0.01, the decision to reject the null hypothesis was made.

2. There appears to be a significant difference between the conventional method of instructing and teaching with the aid of immediate videotape replay.

3. After analysis of the research data, it can be assumed that the conventional method of teaching, verbal instruction, demonstration, practice, and correction is aided by the opportunity to receive immediate feedback of a knowledge of correct results using videotape replay.

4. Analysis of data reveal a significant difference in the form achieved by the experimental group.

5. The use of immediate videotape replay allowed the experimental subjects to advance more rapidly to the more difficult skills which by itself appears to be evidence of its effectiveness.

6. More of the experimental subjects were able to complete the entire basic gymnastic routine which also appears to be an indication of the efficacy of this media.
Suggestions for Further Study

While this study was being conducted, many problems were encountered which indicated a need for further investigation to evaluate better the effectiveness of immediate videotape replay upon the learning process.

1. If research using these variables is to continue, there are certain definite implications from this study which are almost essential. For this age group, strength should be included as one of the variables; also, somatotyping does not appear to be an essential factor.

2. As has been suggested, further research can be directed to comparing the specific motivational contribution made by the presence of the videotape recorder.

3. It is recommended that a comparative study be made to determine the effectiveness of immediate knowledge of results and the effect it has upon learning by the lecture method.

4. It is recommended that a study be made using a similar design to determine the similarities or differences found in other physical education activities; such as, racket games, handball, diving, swimming, and other areas where immediate knowledge of correct results is important.

5. A study should be formulated using individuals who are more advanced in their athletic skills in order to determine whether knowledge of correct results is more beneficial to the highly skilled.
6. A study should be designed which would make provisions for recording a skill and then advancing the tape after recording the individual performance. Upon the next appearance of the subject he is recorded following the first performance with each subsequent performance recorded in proper sequence to determine if knowledge of improvement is essential in learning. In addition, inclusion of the confirmation-reinforcement dimension would be of extreme value.

7. A longitudinal study should be formulated which would allow for rapid advancement of the more highly skilled to compare the efficacy of videotape replay with that of traditional teaching.

8. A study should be formulated to investigate the different effects of extrinsic response confirmation which seemed to be a reflection of prior experience and habits of the learner. It appears that a step-by-step feedback provided by extrinsic response confirmation may be necessary for learners whose learning history included relatively few success experiences. If the subject has a poor reinforcement history which would affect his motivation, then it seems we might expect highly motivated learners to require less feedback than would learners with less motivation.
### Table 4

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APPENDIX B
DATA COLLECTION CARD

NAME: ___________________________ DATE: _____________

DATE OF BIRTH: ___________ AGE: ______ (MONTHS)

HEIGHT: ________ (INCHES) WEIGHT: ________ (POUNDS)

SOMATIC TYPE CLASSIFICATION:

ENDOMORPH: 1 2 3 4 5 6 7
MESOMORPH: 1 2 3 4 5 6 7
ECTOMORPH: 1 2 3 4 5 6 7

MENTAL AGE: ___________

INTELLIGENCE QUOTIENT: ___________

MOTOR EDUCABILITY: (IOWA BRAVE TEST)

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GRAND TOTAL: ___________

PREVIOUS EXPERIENCE:
## GRADE RECORDING SHEET

### GROUP:
- Experimental
- Control

### DATE:

### NAME:

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Physical Education
Colorado State University
RESEARCH PARTICIPANT
Swim Permit

For __________________________

__________________________
Chairman
BIBLIOGRAPHY
Books


Sheldon, William H., Stevens, S. S., and Tucker, W. B.  
*The Varieties of Human Physique.* New York: Harper and Brothers, 1940.


Articles and Periodicals


"What's in a Name?" Quest, Monograph II (Spring Issue, April, 1964), 9-13.


Reports

Unpublished Material


Other Sources

. Personal interview with Bill Astle, Instructor, Statistical Department, Colorado State University, Fort Collins, Colorado, October, 1966.

. Personal interview with Dr. Calvin Butler, Assistant Professor, Statistical Department, University of Colorado, Boulder, Colorado, October, 1966.

. Personal interview with John Modrick, Assistant Professor, Psychology Department, Colorado State University, Fort Collins, Colorado, February, 1967.