AN ANALYSIS OF THE EFFECT OF VIDEOTAPE REPLAY ON LEARNING TO SWIM THE BREASTSTROKE

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ABSTRACT

AN ANALYSIS OF THE EFFECT OF VIDEOTAPE REPLAY ON LEARNING TO SWIM THE BREASTSTROKE

By

Dolores Cady Hageman

The purpose of the study was to analyze the effectiveness of videotape replay in learning to swim the breaststroke. Students enrolled in four intermediate swim classes at Calvin College served as subjects. Classes were randomly assigned to treatment or control groups. It was hypothesized that the treatment subjects who received visual and verbal information feedback via videotape replay would improve more than the control subjects whose information was restricted to verbal feedback in learning to swim the breaststroke.

The procedures in effect during the experiment were as follows: the Kilby glide test plus time was administered during the third class session. The four classes were taught by the same instructor. Lessons were divided into two phases: an instruction and drill phase, and a feedback and workout phase. During the first phase, subjects in all classes were

taught the same way including directions, instructions, demonstrations and drills. During the second phase of each lesson subjects performed the prescribed drill in the deep water tank. Subjects in the treatment group were videotaped at this time. Following the drill, subjects practiced according to a posted schedule. During the practice portion of the lesson the subjects in the treatment group individually viewed their videotaped performance and received verbal error information feedback whereas the control subjects received only individual verbal feedback information. All subjects were asked to refrain from practice outside of class.

The Kilby glide test plus time which required the subjects to swim the breaststroke for twenty-five yards, was again administered during the seventh week of the study. Subjects were randomly assigned to a testing time during the evening testing session. Four dependent variables were obtained from the test--number of strokes, number of errors, total count (strokes and errors), and the time required to complete that distance.

Descriptive and inferential statistics were computed for the pretest, posttest, and gain score data of these measurements. The treatment group mean scores revealed that they performed better initially than did the control group. Significant differences between groups were determined through the use of t-tests. The results revealed that there were no significant differences between the treatment and

control group gain scores at the .05 level. Tests for significant differences between pretest and posttest scores demonstrated that improvement occurred for both groups in the technique variables, but not in the time variable.

It was concluded that a combination of videotape and verbal feedback was not more effective than verbal feedback alone in learning to swim the breaststroke. Improvement scores in technique variables rather than the product variable (time) indicated that learning was affected by the instructor's objectives.

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CHAPTER I

THE PROBLEM

One of the fundamental purposes involved in the use of movie films or videotape replay is that of providing information feedback to the performer. Through the replay, the performer receives visual information concerning the performance and can determine if the response accurately duplicates the original skill concept. This information often results in correction of errors during the next performance.

Some investigations have focused on the value of repeatedly providing the performer with correct skill patterns via films of expert performers. However, the necessity of regular observance of a skilled reference pattern has not been demonstrated (Nelson, 46, Wyness, 71; Brown and Messersmith, 12; Carre, 14; Newfeld and Newfeld, 47; Caine 13; Lloyd, 41). Carre (14) suggested that if an initial understanding of the skill pattern is adequate, repeated model showings are unnecessary. Although repeated observance of model performance is not essential for error corrections,

review of one's own performance can result in reassessment and change in performance (Wren, 70; DeBacy, 22; Clifton and Smith, 17; Watkins, 68).

The effect of visual feedback on performance is influenced by several factors. These factors include arrival time, stage of learning, and the nature of the task (Robb, 56). Films supply delayed visual feedback due to the time required for processing. Such delayed feedback is not as effective as the immediate feedback provided by videotape in learning various gross motor skills (Lloyd, 41; Jones, 35; Priebe and Burton, 54; Brown and Messersmith, 12).

The effectiveness of augmented visual feedback at various levels of skill is not clearly established. Several studies have yielded significant results using beginners as subjects (Hainfeld, 31; Thompson, 66; Morgan, 45; Paulat, 49; Patterson, 48; Del Rey, 23). Others suggest that this type of information feedback is more effective after the initial learning stages (Nelson, 46; Berlin, 8; Jones, 35; Lawther, 39; Plese, 52; Green, 30; Carre, 14; Watkins, 68). Some studies suggest that learners at the middle skill levels benefit the most from such information feedback (Lloyd, 41; Taylor, 65).

The nature of the task affects the value of immediate feedback as provided by videotape replay. Although skills involving object projection do not provide direct performance information, they do provide inherent knowledge of results through observation of the distance or the effect of the

projectile. The acquisition of object manipulation tasks has not been shown to improve significantly with additional videotape feedback irrespective of whether skill technique or results of performance were measured. Carre (14), Gasson (28), Sanders (60), Caine (13), and Cooper (19) found no significant improvement for groups receiving augmented visual feedback in skills such as the discus throw, badminton wall volley, volleyball wall volley, bowling, and certain basketball skills, respectively. However, Cooper (19) and Del Rey (23) concluded that videotape replay significantly improved performance in skills emphasizing form and accuracy.

Augmented feedback enhances the learning of skills in which little intrinsic information is available. Performance of closed skills in general, and body manipulation skills specifically, has been shown to improve significantly through the use of videotape information feedback. These are skills in which the performer cannot see performance results environmentally. Plese (52) obtained improvement in parallel bar performance with the videotape replay group. He suggested that videotape replay is significant for skills in which the performer's body and/or body segment positioning affects the skill. Other studies obtained similar results for modern dance (Patterson, 48) and swimming (Morgan, 45; Green, 30; Newfeld and Newfeld, 47; and Taylor, 65).

The effectiveness of videotape feedback as a teaching method for body manipulation skills is apparent from

these results. Due to the nature of the environment in which it is performed, swimming is a body manipulation skill for which there are limited means of providing immediate feedback. Therefore, the effectiveness of videotape replay in teaching a swim stroke is a viable problem.

Need for the Study

The nature of swimming is such that the participant cannot view the execution of the skills inherent in this activity. Classes in swimming skills provide instruction in stroke execution--technique. Since swimming skills emphasize form and body manipulation, the use of augmented feedback may be beneficial (Cratty, 21).

Most studies using augmented feedback have involved beginning level learners. Many results indicate, however, that beginners have too many variables to be concerned with to benefit from television replay (Plese, 52; Morgan, 45; Berlin, 8; Lloyd, 41; Carre, 14; Lawther, 39). It has been suggested that augmented feedback is more helpful after beginners are more familiar with the task. The present study dealt with intermediate swimmers.

Most intermediate swimming classes include instruction in the breaststroke. Although intermediate swimmers may not display correct technique, most of them can demonstrate a minimal knowledge of what the breaststroke looks like and may have attempted to perform it. Therefore, the skill involved in the study was not a novel skill to the

learners. On the other hand, few intermediate swimmers are able to demonstrate an accurate or efficient breaststroke. Few studies have focused on the value of videotape replay in helping the swimmer refine or even relearn a skill.

Several authors have used underwater photography to analyze swim strokes (Alterveen, 2; McCatty, 44), but few have used underwater videotape filming to provide information feedback. Taylor (65) videotaped his subjects from the deck of the pool. Green (30) taped below the surface three times but did not determine if these tapes made any difference in the rate of learning pre-beginning and beginning swim skills. The nature of the environment in which swimming strokes are performed causes some unique problems with surface filming. Refraction causes distortion whereas splashing and surface waves cause concealment (McCatty, 44). On the other hand, underwater photography allows the student to see arm and leg movements underneath or below the body. Also, most of the instructional models seen on charts and diagrams use underwater views of swimmers. Therefore a study using underwater filming may provide useful information in the effectiveness of augmented feedback in learning a swimming stroke.

Statement of the Problem

The purpose of this study was to investigate the effectiveness of videotape replay as a teaching device in learning to swim the breaststroke. Specifically, this study compared the effectiveness of augmented (supplementary),

terminal, visual and verbal feedback via videotape replay with the verbal feedback provided by the instructor alone. The objective was to compare learning of the breaststroke between two groups of college, intermediate swimmers. One group received videotape replay of the breaststroke performance during practice time while the other group received practice time without videotape replay. The difference between the pre- and post test scores on the Kilby glide test plus time determined the effectiveness of the videotape replay method.

Research Hypotheses

It was hypothesized that teaching with videotape replay would result in significantly more learning than teaching without replay for intermediate swimmers learning the breaststroke. Thus, it was hypothesized that students in the swim classes taught the breaststroke with the use of videotape replay would have better performance scores (the difference between the pre- and post test scores) than those taught without the replay.

Research Plan

The students enrolled in four coed Swim II classes held at Calvin College, Grand Rapids, Michigan, served as subjects. The Kilby glide test plus time was given to obtain initial performance scores. Classes were randomly assigned to treatment or control groups. Both groups

received conventional instructions followed by a prescribed practice period. Stroke demonstrations were videotaped and shown to all classes. The instructional phase of each lesson (lasting approximately twenty minutes) concluded with each swimmer performing the stroke or part of the stroke in the deep water tank. The order for this drill was randomly assigned and rotated daily. During this drill, the experimental group was videotaped. The instructor made notes of each individual's problems with technique at this time. The subjects then worked through the posted work-out schedule for the last fifteen--twenty minutes of class. During this time, the subjects in the treatment group individually reviewed their tapes with the instructor. The control group subjects received only a verbal review of their performance from the instructor. Each lesson included a review and/or practice of the breaststroke or some part of the stroke. Students were asked to refrain from practicing the stroke except in class. The Kilby glide test plus time was administered again during the seventh week. Gain scores were used to account for initial group differences. T-tests for significant differences between the means of the gain scores were used to determine if there were significant differences between groups.

Rationale

The purpose of this study was to investigate the effectiveness of videotape feedback in learning to swim the

breaststroke. A two group design was chosen because it is the most direct method of comparing one method of instruction with the traditional method.

The breaststroke is the best single stroke to use to catagorize swim students (Torney and Clayton, 67). While advanced swimmers demonstrate acceptable breaststroke form, students with a poor kick and poor arm pull form are generally classified as beginning level swimmers. The breaststroke therefore is a skill taught primarily to intermediate swimmers and thus was the stroke used in the study.

No optimal schedule of practice time has been established for learning a given task (Robb, 58). Taylor (65) found no significant differences between groups after five instructional periods when teaching the whip kick portion of the breaststroke. Plese (52) used a fourteen lesson plan in teaching a gymnastics routine to demonstrate the effectiveness of videotape replay. Morgan (45) used only three instructional/practice periods to teach beginners the butterfly arm pull with breathing. The learning of a skill involves not only acquiring a general picture of the sequential organization of the task--as provided during the instruction phase--but also temporal patterning, refinement of coordination, and eventually automatic execution of the skill (Robb, 58). Subjects need enough time to form and organize subroutines, to learn the correct neuromuscular patterns, and to practice the complete stroke as well as

parts of the stroke, especially if they were only allowed to practice during class time. Seven weeks were planned for the study to allow for these phases of learning. This time included one week of preliminary class orientation; one week of testing, procedure orientation, and instruction in and practice of swimming mechanics; two weeks of instruction and practice devoted to the breaststroke alone; and, three weeks of instruction in other swim skills with brief reviews of the breaststroke. Since spring vacation occurred after the first seven weeks of the semester, the final testing was done before the break to avoid the influence of extraneous independent variables.

The lesson procedures are based on the investigator's previous experience in teaching the breaststroke and in using videotape for instructional purposes. The procedures and situations are similar to regular class situations in order to make the conclusions relevant to a realistic class setting. For example, all Swim II classes are coed, therefore both sexes were included in the study and in each group. The control group had eight males, and thirteen females; the treatment group had eleven males, and fifteen females. All the subjects in a class are usually instructed in a similar manner, therefore, treatment was assigned to classes rather than to individuals within classes. Individual videotape review has been found by the investigator to be more helpful and less time consuming than group review, therefore this method was chosen.

As noted previously, this stroke is not novel to intermediate swimmers and each class contains a range of ability in such a skill. To meet the objective of this study, a pre-test, post-test design was chosen. Most intermediate swimmers have had enough swimming to be aware of the general breaststroke motions and can attempt to imitate these with sufficient proficiency to swim 25 yards, therefore this pretest was used. Many Swim II subjects were not sufficiently efficient to swim much more than twenty-five yards. However, as the subject learned the skill, less extraneous motions were used and the skill became more efficient. A timed, 25-yard stroke count test was used as the pretest and post-test since it basically measured the efficiency of the stroke. A test which also considered errors in performance was chosen because such a factor increased the validity of the test. Students could swim twenty-five yards but use a scissors kick (or any improper kick) initially. This type of test penalized illegal kicks or pulls and therefore made the test more valid. The differences between the pretest and posttest scores indicated the amount of learning that took place during the study.

Assumptions: The following assumptions were made:

1. Skill learning could be measured by the performance test;
2. Subjects did not receive visual feedback of their performance by any means other than the treatment;

3. Students refrained from practicing the stroke outside of class and therefore learning was the result of class participation;
4. Training is specific and therefore activities other than the breaststroke performed outside of class did not affect learning of this skill;
5. All students had the same input to produce a mental image of the breaststroke. This image served as a reference pattern by which they made error corrections in their stroke;
6. The instructor gave unbiased direction and affective feedback.

Delimitations

The problem was delimited to students attending Calvin College, Grand Rapids, Michigan, who were classified as intermediate swimmers. Students enrolled in four Swim II classes, taught by the same instructor, comprised the sample. The study was limited to a seven week period. Class periods were forty minutes long and each of the classes met twice a week. Two pools were used--the deep water diving tank and the competitive pool which is 25-yards long and 4 feet in depth. The pools are located next to each other.

Throughout the experiment, the following pieces of videotape equipment were used: Videotape recorder--Sony model CV-2200, serial number 6538, Monochrome video monitor (19 inch screen)--Sony model CVM-180U, serial number

16604494, Monochrome video camera with viewfinder--Sony model CVC-2100A, serial number 15871 and Sony model CVF-4, serial number 14231. The camera and viewfinder were located directly in front of an underwater viewing window, using a 12.5 mm, f1:1.4 lens opened to an f-stop of 5.6 and focused at an arbitrary 15 feet setting. The composite video signal generated in this arrangement was sent via a single cable to the videotape recorder located along with the 19 inch monitor on a balcony-like area close to the pool itself. Each subject individually viewed the replay in black and white image on the television screen located about one foot above eye level (six feet). The videotape replay was run at the same speed at which the skill was performed.

Limitations: The investigator recognized the following weaknesses in the study:

1. Human judgement was involved in determining performance errors.
2. Only students enrolled in these Swim II classes were able to participate.
3. Personality types and degree of motivation could not be controlled in the study.
4. The expertise of the television operator and the vulnerability of the equipment could have affected the results.
5. Class size and sex ratios within the classes could not be controlled.

6. The experimenter could not control mental practice or prevent subjects from observing the breaststroke performance of other students during class or outside of class.

Significance of the Study

A study of this nature provides important information for teachers concerning methods. The study may also supply valuable guidelines for teacher preparation.

Videotape equipment is expensive. Studying the effectiveness of videotaping in teaching skills will provide quatitative data to use for comparing the value of this method in terms of cost with its value in terms of production. In addition, the value of time spent in videotaping and reviewing as opposed to that expended in actual practice is an important issue for instructors. Studying the effectiveness of videotaping in learning a sport such as swimming allows teachers to make knowledgeable decisions concerning the value of videotaping situations that involve motor learning.

Instructors of intermediate level performers are often faced with the problem of breaking old habits or changing misconceptions the student has concerning skills. For example, many intermediate swimmers use a scissors kick to propel themselves in the breaststroke. Using the Kilby test, these kicks are counted as errors. An indication of the effectiveness of videotaping in changing this habit may

be obtained by comparing pre-error and post-error scores. The value of this means of visual feedback in assisting in the relearning process could be important to instructors working with students at this ability level.

Professional preparation programs may be encouraged to place more emphasis on this medium if the technique is beneficial. The use of videotape emphasizes the importance of knowledge of performance or the process of skill execution as opposed to emphasizing the results of performance i.e. distance, time, etc. If videotape replay is helpful, instruction in skill analysis with an emphasis on technique may play a more important role in teacher preparation, especially preparation for instruction of certain skills such as body manipulation tasks.

The results of the study may also suggest important factors concerning the techniques of videotaping. For example, the importance of underwater viewing as opposed to surface viewing may be a consideration. Other technical considerations might be the value of individualized or group review, the necessity of using a trained technician, how often review is necessary.

Definitions

Information feedback--knowledge of performance or results provided to the learner that gives cues and which if correctly translated guides the learner to correct responses toward a desired reference pattern (Bilodeau, 10).

Intermediate swimmer--a student who is nonfearful of water and who can propel through the water for a distance of twenty-five yards using a front stroke, twenty-five yards using a back stroke, survival float and tread water for one minute (Calvin College minimal swim test).

Practice--when students perform the skill by swimming various times and/or distances. During this time the instructor will give individual correction concerning stroke performance.

Videotape replay--the process of replaying the videotape taken of each student's performance. The replay is a visual review of the performance.

Closed skills--movements that are relatively stereotyped and predictable, performed in a relatively stable environment (Robb, 59). Examples of closed skills include swimming, diving, gymnastics, and dance skills.

Knowledge of performance--information concerning the process of executing a task--understanding how a skill is performed.

Knowledge of results--information concerning the outcome of performance--how far, accurate, etc., the performance was i.e., knowledge of products of performance.

Open skills-movements in which sterotyped patterns are limited and in which environmental requirements are unpredictable (Robb, 59). Examples of open skills include soccer, dodgeball, and hockey skills.

Breaststroke--a swimming skill swum on the surface of the water with the shoulders horizontal to the surface. The arm-pull and leg kick are made underwater. A portion of the swimmer's head breaks the surface before the next stroke is started. The whip kick and short arm pull with the hands leading the pull going down and out will be used (DGWS Aquatic Guide, 1925-1975).

Stroke count--the number of strokes it takes the subject to swim twenty-five yards from a stationary prone position. One stroke includes one arm pull and one leg kick.

Gross motor skill--a skill in which large muscle groups are involved or large movements are made.

Fine motor skill--a skill in which small or few muscle groups are activitated and movements are small.

Augmented feedback--information supplementary to that provided by the task (Robb, 55).

Intrinsic feedback--information inherent in the task (Robb, 55).

External feedback--information provided by the sense organs concerning the environment outside the body (Robb, 55).

Internal feedback--information provided by the sense organs concerning the internal environment of the body (Robb, 55).

Concurrent feedback--information present during task execution (Drowatsky, 26).

Terminal feedback--information available after the response is completed (Drowatsky, 26).

Reference patterns--performance models or the learner's conception of the skill patterns (Bilodeau, 10).

CHAPTER II

RELATED LITERATURE

The literature dealing with the concept of information feedback and the factors effecting it is voluminous. For example, the reader may refer to the writings of (Robb (57); Adams, Goetz, and Marshall (1); and Bell (6) for information concerning the arrival times of feedback; to Annett (4); Bernasconi (9); Bell (7); Berlin (8); Wills (69); Chansky (16); and Jordan (36) for information comparing types of feedback; and to Judd (37); Spencer (63); Lloyd (40); and Pierson and Rasch (51) for information concerning the value of feedback.

This chapter is a review of the literature involving information feedback and its relationship to gross motor skill learning. Feedback will be identified and defined. Feedback via film or videotape replay will be examined. The factors of arrival time, level of learning, and nature of the task will be reviewed as they relate to visual supplementary feedback.

Feedback

Bilodeau (10) has identified several general terms in the research literature which indicate the functions of feedback. These include information feedback, knowledge of results, reinforcement and reward. The terms information feedback and knowledge of results identify the nature of feedback whereas reinforcement and reward identify its uses. Knowledge of results emphasizes the subject's awareness of the outcome of the response. The outcome may be in terms of points scored, distance covered or target hits. Information feedback involves stimuli under the experimenter's control which provide the performer with information concerning discrepencies between the goal and the actual results (Bourne, 11). This is the type of feedback videotape replay and films provide.

Definition of Feedback

The information of a skill begins with some conception of that skill (Lockhart, 42). The performer hypothesizes what the skill is like and how to perform it. Once the performer has an idea of what the skill is, an attempt may be made to perform it in accordance with this concept. The performance is then compared to the concept to determine if the skill was accurately completed. Feedback thus is the information used by the performer to compare the response to the reference skill (Robb, 55; Robb, 56; Bilodeau, 60).

> Feedback can be described as a return of part of the output, or response, to the input; this may lead either to a revision of the response just made or to a confirmation of the response as being correct (Drowatsky, 26; pp. 85).

Information feedback, therefore, helps direct or regulate the performance (Stallings, 64; Bilodeau, 10).

Reference Patterns

In order for the performer to use the information provided by replay to correct errors, a conception of the skill pattern is necessary. Several studies have dealt with the use of filmed models to provide the framework for skill patterns. Most of these investigations demonstrated that repeated model useage does not significantly improve performance (Nelson, 46; Berlin, 8; Priebe and Burton, 54; Caine, 13; Wyness, 71; Carre, 14; Brown and Messersmith, 12; Newfeld, 47; Lloyd, 41).

There is limited evidence that subjects may benefit more from repeated viewing of the reference pattern after initial learning stages rather than during beginning stages of learning. Lockhart (43) used a film designed especially for use with beginning bowling classes. The treatment group viewed either parts of or the entire film throughout the instructional unit. Critical ratios and learning curves were computed and revealed that the rate of improvement in the movie group was more consistant than that of the control, especially after the third week. Nelson (46) employed loop

films of male and female golfers filmed at various angles while using the 7-iron. Using gain scores based on points earned by closeness to a target, he found no statistically significant difference between experimental and control groups. He did note, however, that slow motion loop films seemed to favor the later stages of learning. Berlin (8) used the golf swing, soccer punt, fencing lunge, tennis serve, and lacrosse catch to compare the use of various teaching methods. She also concluded that after initial learning, subjects are helped by various techniques including film aids.

With such meager supportive evidence, the value of repeatedly viewing a reference pattern might be questioned. Carre (14) maintained that as long as the subject had a well developed idea of the skill, repeated viewing of an expert performing via film was not needed. Rather, once the subject had an idea of what was required, time was more efficiently used in trial-and-error attempts at performing the skill.

Augumented feedback allows the subject to assess performance to see if it was what it was intended to be. DeBacy (22) studied the effect of videotape replay of golf on self-assessment. She used a two group design. The subjects were exposed to treatment after seven weeks of instruction. During the treatment session, the subjects from both groups came individually, read standard directions, warmed up, hit four balls, viewed four model performances, and rated their swings as poorer than, better than, or equal

to the model performance. The experimental group subjects then reviewed their own performance and the performance of the four models again. The control subjects observed the models' performance again but did not see a videotape of their performance. Both groups then reassessed their performance. Five judges also rated each subject using the same scale. The experimental group reduced their over-assessment by 37 percent while the control group reduced theirs only 5 percent. Viewing model and personal performance improved assessment to the extent that the experimental group's assessments were not significantly different from the judges' ratings. It should be noted that videotape replay was not used until after completion of the initial learning phase of seven weeks.

Error Correction

Augmented visual feedback eliminates much ambiguity in communication between instructor and student because both can review the student's performance at the same time (Cratty, 21). Reviewing play via films or television has helped the coach or teacher see what needed to be improved and has assisted the player in understanding what the teacher wanted (Speed, 62; Hughs, 34; Coffey, 18). Thus, films provide the individual with direct information by which personal performance can be assessed and errors in performance can be observed and corrected.

The role of films in effecting change in self assessment of throwing performance was shown by Clifton and Smith (17). Sixty college men and women volunteers were randomly placed in an experimental or a control group. During the first phase, the subjects performed fundamental skills such as walking, running, throwing, catching, and long jumping. They were then given a checklist to rate their performance as favorable or unfavorable. After four weeks with no additional practice, the experimental subjects viewed loop films of their performance while the control group performed the skills again. All then re-evaluated their performance. The authors concluded that viewing the motion picture of throwing performance resulted in positive changes in assessment scores.

Videotape replay has also been effective in improving balance performance from one day to the next without practice. A study by Wren (70) involved seventy-two second, fourth, and sixth grade children given task of standing on a platform, on signal moving the platform to a level position, and maintaining this position without assistance. After twelve trials on the first day, members of the experimental group viewed their videotaped performance. Both groups were given five trials on the second day. Results indicated a significant difference in performance between the two groups with the experimental group superior at each grade level. It was assumed that the subjects receiving videotape replay assessed their performance because of what they saw and changed their performance the next day. Although learning,

i.e., more permanent change in performance (Drowatsky, 27), was not involved in this study, it demonstrated that feedback affects change in performance. It is inferred that this change is due to the error corrective information provided by feedback.

The fact that performers correct errors after seeing their performance was also demonstrated by Watkins (68). He used motion pictures as an aid in correcting baseball batting faults. He filmed at the beginning of the experiment, at the end of the third week, and at the end of the fifth week. The experimental subjects reviewed the most recent films without receiving corrections and then were reshown the films and given corrections. The experimental group thus received an additional three minutes of instruction while the control group did not see films or receive extra instruction. Instruction during regular practice was the same for both groups. The experimental group significantly decreased in number of batting faults ($p = .01$) as rated by a judge using the Vana batting criteria. The treatment group showed the greatest amount of improvement during the first three weeks. Since advanced skill level subjects were used in this study, the objective of the film review was to correct a skill already learned.

Factors Affecting Feedback

Robb (56) has identified three specific factors which affect the role of feedback: (a) the stage of learning,

(b) the task to be learned, and (c) the arrival time of feedback. Some studies show that augmented feedback is more effective during the later stages of learning. The difference in level and speed of learning may be due to differences in tasks since feedback is task specific (Ammons, 3). Arrival time is important in that the longer the delay in feedback, the less effect the information has on error correction.

The major means of providing the performer with visual, augmented feedback have been films (motion pictures, loop films, graphcheck pictures) or videotape replay. Both types of media provide the learner with error correction information. However, videotape replay provides immediate feedback while films usually involve delayed feedback.

Arrival Time

Although films can provide an excellent means of augmenting information feedback, the film development process creates a time lag which results in delay of information feedback. Most studies in which films have been used to provide augmented visual feedback have failed to obtain significant results regardless of the type of task involved. For example, Wyness (71) failed to obtain significance in his study which involved learning to put a sixteen pound shot. Jones (35) used long and short badminton serves and obtained no significant difference in learning between the group reviewing films of personal performance and those not reviewing performance. Lloyd (41) obtained similar results

using tennis ground strokes. Priebe and Burton (54) and Brown and Messersmith (12) also found that film feedback did not significantly enhance the learning of body manipulation tasks.

Pictures of models and/or self performance do not increase over-all learning more than teaching without such aids (Wyness, 71; Lloyd, 41). Wyness (71) divided his subjects into four groups to learn to put the shot: a control group, a treatment group observing pictures of themselves twice a week, a treatment group reviewing an adept model twice a week, and a treatment group reviewing pictures of themselves once a week and of a model once a week. Analysis of covariance revealed no significant difference between groups. Lloyd (41) studied the stage of learning at which feedback and model comparisons were useful in learning tennis ground strokes. His study also involved four groups. Group I viewed loop films of personal performance (taken the previous week) and films of experts during the fifth week of the study. Group II viewed its performance and loops of experts during week eight. Group III viewed similar films during week eleven. Group IV was the control. Lloyd found significant differences in gain scores among the groups at the end of sixteen weeks. It was concluded that slow motion pictures imposed at various stages in learning did not affect ultimate learning although viewing during the middle stages of instruction provided a temporary stimulus to learning rate. This early learning advantage was not maintained.

Similar results were obtained by Jones (35) who tested the learning of two badminton serves and by Priebe and Burton (54) and Brown and Messersmith (12) with high jumping and tumbling skill learning; respectively. Subjective and objective evaluations were obtained at the conclusion of Jones' study, but the range of ability of the two groups was too great to indicate statistically significant gains in learning. However, the experimental group did make gains between the first and third test periods, while the controls did not. In both body manipulation studies the treatment group saw films of experts during the early part of the studies and reviewed films of themselves later in the study. Priebe and Burton compared the average high jumping heights of both groups and found that the experimental group outjumped the control after the third, fourth, and fifth week. However, the control group outjumped the experimental group after the final (thirteenth) week. They concluded that slow motion pictures were effective at first but did not make a difference as learning progressed over extended time periods. Brown and Messersmith used judges' ratings for assessing performance in their study. They questioned the use of films for beginning tumbling in view of the cost and the lack of positive results obtained. Instead, they suggested that class time might better be used for practice.

The failure of studies utilizing films to obtain significant results was possibly due to the inherent delay of the information feedback. Studies in which this delay

was minimized have been more positive. For example, Hainfeld (31) found improvement in beginning swimming skills after providing information feedback the day after the filming occurred. Since the learner received this feedback before any additional instruction was given, the feedback was relatively immediate. A higher percentage of the beginning swimmers who saw their performance were able to jump into the pool, level off, and swim twenty-five yards than those not observing their performance. The filming occurred during day three and was replayed before lesson four. The subjects in the study were classified as non-swimmers but the investigator did not identify the criteria for that classification or note whether fear of water was considered, a factor which might affect the results. The study lasted only six days so it is doubtful how much learning could have occurred in such a short period of time.

Immediate feedback can also be provided with polariod pictures. Thompson (66) found significant differences in groups using graph check films involving an eight picture sequence of beginning golf subjects. The pictures were taken once a week and reviewed by the experimental group three times a week. Three golf tests were administered over the term. Significant improvement (.01 level) attributable to the use of immediate feedback as provided by the graph check pictures was obtained.

In many of the studies using films, the review of the film did not occur until several lessons or even weeks

had passed. Therefore, the delay was not only considerable but also disruptive to learning. Between the performance and the review, learning may have occurred or performance may have changed. Thus the delay resulted in an inaccurate representation of skill performance. For example, Brown and Messersmith (12) filmed during lesson nine but showed the films during lesson thirteen. Lloyd (41) showed the films the week following the filming. Film processing took three days in Jones' study (35). Subjects in her study were viewing the same films from December 4 through January 14. These films were inaccurate during the latter part of that period.

Most of the previous studies which failed to demonstrate the effectiveness of visual feedback had three factors in common: feedback was delayed, beginners served as subjects, and comparisons were made with filmed experts. Therefore, the information feedback provided by these studies may not only have been inaccurate, but also disturbing. Generally, those studies in which significant differences were found in favor of performers who viewed films did not use films of experts for performance comparisons. These studies also reduced delay considerably, therefore providing a more accurate, useful picture of current skill behavior.

Videotape replay provides immediate information feedback and therefore eliminates the factor of arrival time affecting results. Immediacy of knowledge of performance is important to the learner (Cratty, 21). The longer the delay between performance and feedback, the less effective the

information (Ammons, 3). The learner needs sufficient time to process information feedback, however, too great of a delay will result in the correction being forgotten or losing its relevance (Stallings, 64). In recent years the use of television replay has increased. The immediacy which this media provides eliminates many of the delay problems noted previously, therefore the error corrective nature of augmented feedback can be effective.

Level of Learning

The level of learning might affect the results of augmented information feedback. Lloyd (41) suggested that students in the middle third skill level improved significantly due to viewing during the middle stages of instruction. Priebe and Burton (54) concluded that films helped in the early stages of learning experiments. Jones (35) showed that the experimental group learned significantly more during the early part of the study. Hainfeld (31) and Thompson (66) found significant learning for beginners in two types of skills. Green (30) concluded that the effectiveness of television replay on learning was dependent upon the ability of the group. Only one author suggested that age may ba a factor responsible for the success in using videotape to teach motor skills to children. Trainable retarded children served as Smith's (61) subjects in a study comparing traditional teaching to teaching with videotape feedback. The skills included balance tasks, obstacle course tasks, and

ball handling skills. Gain scores for the age groups were compared as provided by the evaluations of a team of experts. The teenage group was the only group revealing significant improvement due to the information feedback provided by videotape. The results may reflect the idea that certain cognitive skills may be necessary before the error information can be integrated and used meaningfully.

There is evidence that beginners benefit from augmented, visual information feedback. Priebe and Burton (54) demonstrated that slow motion pictures were valuable early in learning but not as learning progressed. Hainfeld (31) and Thompson (16) found significant results in film studies involving beginners as did Morgan (62), Paulat (49), Patterson (48), and Del Rey (23) using videotape with beginners. Penman, Bartz, and Davis (50) concluded that videotape was more effective with poorly skilled (remedial) students.

Contrary to these conclusions that poorly skilled (beginning) students benefit more from replay, there is considerable evidence to support the idea that information feedback is more effective after the performer has gained some proficiency in a skill. Lawther (39) suggests that moving pictures and loop films help the learner in form analysis at higher skill levels. He recommends that extensive use of the aids with beginners is questionable. While studying gymnastics skills, Plese (52) revealed that the separation in learning between the control and experimental

groups started with the inclusion of more advanced gymnastic skills in the teaching sequence. Green (30) concluded that advanced beginners profit more from videotape replay than did beginners in learning swimming skills. Morgan's (45) study suggests that beginning swimmers may not take advantage of videotape learning. Carre's (14) study of the discus throw supported the idea that videotape may not be effective for beginners by noting that early learning is trial and error and the beginner cannot assimilate large amounts of information.

Investigations using delayed feedback also suggest that subjects beyond initial learning stages benefit most from replay. Jones (35) obtained significant gains in the experimental group between the first and third test. Nelson (46) concluded that slow motion loop films seemed to favor the learning of golf skills in the later stages but not in the early stages. Berlin (8) noted that the beginner seemed to need uninterrupted practice, and after initial learning, subjects seemed to be aided by varied teaching techniques including movies. Finally, Watkins (68) used varsity players and found significant differences in correcting batting faults.

The middle stage of learning may be more affected by visual augmented information feedback than later or earlier stages. Taylor (65) compared the groups according to high, middle, and low skill level in learning the whip kick in swimming. The factors he studied included videotape replay,

verbal replay, and combinations of each, as well as initial skill level. He concluded: (a) treatments were equally effective for subjects at the high skill level, (b) videotape replay plus verbal feedback were more effective than no feedback for subjects at the middle skill level, and (c) videotape replay plus verbal feedback was superior to verbal feedback or no feedback for subjects at the low skill level. These conclusions are contrary to those of Penman, Bartz, and Davis (50) but similar to those suggested by Lloyd (41).

From these studies, it appears that the evidence is not conclusive that level of skill alone affects learning as it relates to information feedback. Most of the studies cited were done with beginners. Both positive and negative results were obtained. Studies in which periodic testing revealed the amount of learning that took place in given time, generally indicated that beginners benefit more after they understand the skill. There is less evidence indicating that highly skilled players are helped by such feedback. Watkins (68) and Penman, Bartz, and Davis (50) indicated that varsity players or the best performers benefited from replay. Taylor (65), Priebe and Burton (54), and Lloyd (41) revealed contrary findings. In general, there seems to be indication that subjects in the middle levels of skill do significantly benefit from immediate or delayed information feedback. There does seem to be agreement that feedback is most effective during the practice phases of learning a skill (Robb, 58). Exactly how early in practice has not been established.

Nature of the Task

Feedback is task specific (Robb, 56). It is the teacher's task to augment information and to call the learner's attention to it (Stallings, 64). The types of tasks studied by various authors can be categorized as open or closed (Poulton, 53). Such skills as swimming, dancing, and tumbling are closed skills. The most effective type of feedback for closed skills (in which stereotyped form is important) is terminal augmented feedback as provided by performance replay (Robb, 59). Such skills as baseball batting and basketball guarding are open skills. A major source of feedback for these skills is the environment (Robb, 59).

Skills can also be classified as tasks involving object projection or body manipulation. Object projection skills provide knowledge of results in which the speed, distance or accuracy of the object provide the learner with immediate, extrinsic feedback. Many of these skills are classified as open skills. Body manipulation skills, on the other hand, provide little extrinsic feedback and depend primarily on proprioceptive information. These skills are closed skills requiring augmented information feedback. The performer cannot see the performance, and therefore is more likely to benefit from supplementary information which demonstrates performance. However, for this information to be valuable, immediate feedback would be most effective.

The results of studies employing delayed information feedback did not appear to be dependent on the type of task involved. For example, studies failing to show significant results involved both body manipulation and object projection. Priebe and Burton (54), and Brown and Messersmith (12) used body manipulation skills, i.e., high jumping and tumbling. Jones (35), Wyness (71), and Lloyd (41) used object projection skills, i.e., badminton serves, shot put, and tennis ground strokes. Studies in which positive results were obtained also employed various types of skills. Hainfeld (31) used a swimming, a body manipulation skill. Watkins (68) and Thompson (66) used object projection skills, i.e., baseball batting and the golf swing.

Augmented information feedback as supplied by videotape replay is especially critical in skills with little intrinsic feedback such as body manipulation skills. Where there is sufficient knowledge of results inherent in a task, additional knowledge of results does not affect further acquisition or retention of a skill at the beginning level (Bell, 6). The value of this type of information feedback in skills with little intrinsic feedback has been established reguardless of the means used to measure the dependent variables--i.e., despite whether the process or product was measured. For example, Carre (14) used form ratings of the discus throw as well as distance measurements. He found that there is a significant correlationship between performance measures of form and distance. Yet, he failed to

demonstrate the effectiveness of videotape replay for object projection tasks. On the other hand, Taylor (65) using judges' ratings and Morgan (45) using a timed test both obtained significant results with videotape in learning swimming skills.

Studies using Object Manipulation

Most skills involving object manipulation provide inherent knowledge of results by means of the performer's ability to observe the accuracy or speed of the projectile. With the availability of such information, there is reason to question whether additional feedback is necessary or helpful. Most of the studies involving videotape of such skills failed to obtain significance. For example, Carre (14) obtained no significance using the discus throw, as did Gasson (28) with badminton volleys, Caine (13) with bowling skills, and Sanders (60) using volleyball wall volleys.

Two authors using the object projection skills found significant differences between learning with videotape replay information feedback and learning without it. Paulat (49) used the tennis forehand drive. His study compared videotape replay vs. no replay, loop film models vs. no filmed models, and males vs. females. Using Hewitt's forehand drive test and ratings of two tennis pros, he obtained significance ($p < .001$) for the videotape replay effect. The other effects failed to demonstrate significance. Cooper (19) used the basketball skills of dribbling, layups,

passing, catching, and one hand push shooting. Treatments included feedback types: (a) auditory, (b) visual, (c) both auditory and visual, (d) no instructor feedback, and (e) control. A comparison of pre-and post-instruction measurements revealed significant improvement due to videotaping (combined with audio feedback) in the evaluation of basketball throw for accuracy. He concluded that tasks such as shooting and passing which require correct form in execution may be best learned with this type of feedback.

Another skill which involves form and accuracy is fencing. This skill falls between object projection and body manipulation in that the object is manipulated rather than projected. Form is important and intrinsic and extrinsic feedback are valuable. Del Rey (23) used fencing to study the effects of video feedback and environmental certainty on the form, accuracy, and latency elements of the skill. Factors included feedback--videotape replay or none, environment--certain or uncertain, and three testing times. The results indicated that videotaping resulted in significantly better form and shorter latency periods, but did not improve accuracy. It was noted that in a certain environment such as that provided in closed skills, speed was sacrificed for form. In an uncertain environment (as in open skills) accuracy was traded for speed. These results along with those of Cooper suggest that the objective of learning plays an important role in the nature of feedback. For example,

many closed skills have execution as the objective while object projection skills have results as their objective.

Studies using Body Manipulation

Closed skills in which the objective of learning is to manipulate the body require additional information feedback from the teacher. The performer cannot observe whether the goal was accurately met without such information. Studies involving the learning of such skills have generally found videotape feedback to be helpful. For example, Plese (52) revealed that 47 percent of the experimental group completed a gymnastics routine on the parallel bars with excellent or good scores. Only 26 percent of the control group did so. Patterson (48) determined that beginning dancers in the videotape replay or mirror feedback groups received higher ratings for their performances than did the control group members. Morgan (45) showed significant improvement in speed and power of the butterfly arm stroke for the videotaped groups. Green (30) and Newfeld and Newfeld (47) obtained significant achievement in favor of videotape using the beginning swimming skills. Taylor (65) also obtained significant improvement in learning the whip kick for the middle and low skill level group of swimmers using some form of videotape replay.

Studies of body manipulation tasks have generally found that immediate information feedback enhanced learning. Penman,, Bartz, and Davis (50), on the other hand, failed to

demonstrate differences in conventional and videotape learning of trampoline stunts. However, the procedures and controls of the study were poorly formulated and therefore the findings are doubtful. The authors concluded that although practice time was less for the experimental group, the benefit from viewing the replay made up for it since that group's mean ratings were almost equal to the control group's ratings.

In general, videotape replay has been helpful to subjects most for skills in which they were asked to put their body or body segments in an unfamiliar position. For example, Plese (52) revealed that videotape replay hastened learning of a gymnastics routine on the parallel bars, and that the experimental group also had better form than the control group.

Augmented feedback is imperative when correct body positioning is an important aspect of a skill (Patterson, 48). The study involved the effect of augmented feedback on perception and acquisition of movement sense in modern dance. Treatments included: no feedback, videotape feedback, and mirror feedback. The experimental group came to seven sessions in addition to class times to perform in front of mirrors or to review videotaped performance. The subjects rated their own performance and the performance of other class members. Five judges also rated the performances. The results indicated that video replay and mirror review significantly improved performance and analysis.

Swimming skills are unique in that the environment in which the skills are performed conceals or distorts the body or limb positioning from the teacher's view, thus limiting the teacher's ability to provide accurate feedback. Studies in which swimming skills have been used with videotape indicate the value of such replay with a variety of swim skills.

The Red Cross pre-beginning to advanced beginning skills were studied by Greene (30) and Newfeld and Newfeld (47). Green videotaped from the pool deck. Pre- and post-test comparisons indicated both groups improved but TV replay was more effective than no replay. Newfeld and Newfeld studied 3 to 6 year old mildly, emotionally disturbed children. A second variable which they included was the observation of a videotaped adept model. Analysis of the cumulative days it took a subject to perform pre-beginners' tasks revealed significant interaction of the effects of faster acquisition of skill with feedback of performance over conventional or self plus model feedback.

Videotape replay has also been shown to be effective in teaching various parts of swimming skills such as the arm pull, kick, or coordination. Morgan (45) tested the effects of replay on improving the speed and power of the butterfly arm stroke (with breathing) in beginners. Using the Hewitt glide test, she revealed that subjects who viewed themselves and heard learning cues improved significantly in the test (.05 level). Taylor (65) used a part of a stroke--the whip

kick of the breaststroke, and compared verbal and visual feedback. Skill measurement was determined on the basis of three judges' ratings. The middle skill level groups which used either videotape and verbal feedback or verbal feedback only were significantly better than the control group at that level. At the low skill level, the mean for the replay and verbal feedback group was significantly different from that of the control and verbal feedback only groups. Subjects at high skill levels showed no significant treatment effects. It was concluded that the critical factor in determining the effectiveness of videotape replay was the way it was used.

Summary

Feedback provides the performer with information concerning the accuracy of the performance. This information and the resulting comparison lead to corrections of errors in performance. Several studies have investigated the value of repeated model useage to establish good reference patterns in the learner. It has been found that as long as the performer has a concept of the skill which may effectively be provided by any means, repeated physical comparisons are unnecessary and may even be disturbing to the beginner (Nelson, 46; Berlin, 8; Priebe and Burton, 54; Caine, 13; Wyness, 71; Carre, 14; Brown and Messersmith, 12; Newfeld and Newfeld, 47; Lloyd, 41). Although films of adept models are not necessary, it has generally been noted that viewing

of personal performance does result in improved skill assessment by the performer (De Bacy, 22; Clifton and Smith, 17; Watkins, 68; Wren, 70).

Three factors affecting the role of feedback are outlined by Robb (56): (a) arrival time, (b) stage of learning, and (c) nature of the task. Augmented visual feedback may be provided by films or videotape replay.

Studies in which films were used have generally provided delayed information feedback. There is an important time lag resulting from the development process which causes a delay in feedback. During the delay, skills may be improved or refined, and therefore, the films provide inaccurate information. It has been found that delayed feedback did not improve learning (Lloyd, 41; Jones, 35; Priebe and Burton, 54; and Brown and Messersmith, 12).

Several authors have suggested that the stage of learning affects the value of feedback in learning a skill. Significant results have been found in studies in which beginners served as subjects (Hainfeld, 31; Thompson, 66; Morgan, 45; Paulat, 49; Patterson, 48; DelRey, 23). However, the results of other investigations suggest that information feedback is more effective beyond the initial stages of learning (Nelson, 46; Berlin, 8; Jones, 35; Lawther, 39; Plese, 52; Green, 30; Morgan 45; Carre, 14; Watkins, 68). In addition, Lloyd (41) and Taylor (65) suggest that subjects in the middle stages of learning benefit the most from information replay.

Although the nature of the task apparently does not affect the value of delayed feedback, it does affect the value of videotape feedback. Skills may be separated according to the objective of the task. Object projection skills do not necessarily require additional information feedback in the form of videotape replay because they provide knowledge of results to the performer. Such skills generally have the product (results) as their goal. Studies involving object projection skills have generally failed to demonstrate the value of additional information via video replay (Carre, 14; Gasson, 28; Caine, 13; Sanders, 60; Cooper, 19).

Skills in which the body or parts of the body are manipulated require additional information to let the learner know if proprioceptive information is accurate. These tasks generally have the process as their goal. Results of studies of gymnastic skills, modern dance skills, and swimming strokes or parts of strokes have indicated that immediate information feedback enhances learning at various levels (Green, 30; Newfeld and Newfeld, 47; Taylor, 65; Patterson, 48; Plese, 52).

CHAPTER III

METHOD

The purpose of this study was to determine the effectiveness of videotape replay in teaching intermediate swimmers the breaststroke. The performance of two groups of swimmers was compared. Permission was obtained from the Chairman of the Department of Physical Education at Calvin College for the investigator to ask the students enrolled in instructional classes to participate in this project. Prior arrangements assured that a videotape technician was also available.

Population

All intermediate college swimmers attending Calvin College during the second semester of the school year, 1975-1976, comprised the immediate population. Calvin College is a small liberal arts college of 2800-3500 students. The majority of the students are white, middle class, and of the Christian Reformed religion. The male to female ratio is approximately 50:50. Four semesters of physical education are required for graduation. The target population of the

study are small colleges similar to Calvin, and which provide aquatic instruction.

Sample

All students entering Calvin College are required to take a diagnostic physical education class prior to enrolling in regular physical education classes. During this class, the students receive orientation to the physical education program and are tested for the purpose of diagnosing and prescribing a meaningful physical education program. Included in the diagnosis is a preliminary swimming test which determines if the student is afraid of water and to what degree the student can propel through it. Following the testing period, students are interviewed and programmed into classes. Swim II classes are recommended for the student who desires to develop various strokes including the crawl, the side, the elementary back, the back crawl, and the breaststroke. Students who are afraid of water are recommended for beginning classes. Students enrolling in Swim II classes, therefore, are nonfearful of water. They are highly motivated to learn. Few students entering these classes can perform the breaststroke with any degree of proficiency or accuracy.

Students enrolling in the study classes were asked to complete a questionnaire and to take the Kilby stroke count test. All students indicating that they were not willing to participate in the study were eliminated from it.

A minimum of N = 40 was sought. Each group contained male and female subjects. Forty-seven subjects completed the study.

Experimental Design

An experimental design with independent comparison groups from the available sample was used. Analysis of the pre-test and post-test data differences was made. Treatment was randomly assigned to two classes resulting in an experimental and a control group. The experimental group received videotape replay of the breaststroke, while the control group practiced without replay.

Independent Variables

In this study, the independent variable was the teaching technique. The combination of videotape replay and verbal feedback in teaching was compared to the use of verbal feedback alone without videotape feedback.

Control of Extraneous Independent Variables

Randomization due to enrollment, random assignment of groups to treatment, and assignment to post-test sequence and time were used to control group differences. Each group received the same lessons with the time spent on each element carefully controlled. To control intergroup differences, lesson plans carefully defined all class activities and the same plan was used for all classes (see Appendix B). Films and handouts were the same for each class. To minimize the

effects of differing teacher personalities, the investigator taught all of the classes. Videotaped demonstration was used whenever possible. To control for the halo effect due to the presence of the video equipment, the videotape equipment was in the pool area during the classes of each group--the camera was always out of view below the deck. Students were aware that the study involved videotape and teaching methods but did not know if the treatment consisted of videotaped replay or videotaped demonstrations. They were only told that the study involved teaching techniques. Intermediate swimmers were used to eliminate the fear-of-water factor and the extraneous variables connected with it. Students missing classes were asked to attend make-up sessions the same week. The training effect was controlled by limiting practice of the breaststroke to in-class time and by limiting the length of the study.

The variability in initial skill levels between groups was controlled by using gain scores. The method of obtaining subjects and the research design assured random sample distrubution of obtained scores.

Research Design

Two available samples were taken from the population of intermediate swimmers attending Calvin College. Four classes of Swim II students were randomly assigned to treatment or control groups and pretested. The pretest gave a time, error, stroke, and count (strokes + errors) score for

each person. After the study, both groups were tested again and scores for these four factors were obtained. The gain scores were computed and used to compute t-tests for significant differences between means with $\alpha = .05$, $\beta = .20$. To test for significant learning over the entire study period, a t-test for significant differences between pre- and post-test scores for subjects was also run.

Conduct of Treatment

A seven week study was planned with four Swim II classes participating. The classes met at the following times: Tuesday and Thursday, 1:30 P.M.; Monday and Wednesday, 9:00 A.M.; Monday and Wednesday, 10:30 A.M.; and Monday and Wednesday, 1:30 P.M. Each class was randomly assigned to either treatment or control groups with the result being the Monday and Wednesday, 10:30 A.M.; and the Tuesday and Thursday, 1:30 P.M. classes were assigned to treatment. Lessons were forty minutes long. A progressive-part method similar to the Red Cross progression was used for instruction. Counsilman's descriptions and analysis and AAHPER diagrams were used to supplement these methods (Counsilman, 20; DGWS, 24).

During the first session, an outline of class objectives, an explanation of the study, and a questionnaire were presented as a general orientation to the class and the study. After the first session, all classes met in the pool. During the second class session, water orientation and stroke

evaluation took place and students were oriented to general class procedures. The Kilby test plus time was administered at the beginning of the third class followed by instruction in and practice of the mechanics of swimming. During lesson four rhythmic breathing related to the crawl, bobbing, and jellyfish floating were practiced using the format for class that would be used for the rest of the study. The jellyfish breathing was taught as lead up to breaststroke breathing mechanics. This lesson included taping bobbing for the treatment group. An introduction to the breaststroke technique in general was presented in lesson five.

After students understood the stroke generally, the arm action, leg action, coordination, etc., were studied and practiced. During lesson five and six the whip kick was taught and progressively practiced. Lesson seven included instruction and practice in the arm pull; lesson eight instruction and practice in breathing and coordination. After this initial instructional phase was completed, a general review phase was begun. Starting with lesson nine, other skills such as diving and the crawl stroke were introduced during the first fifteen minutes of class time. A part of the breaststroke was reviewed, practiced, and taped during the last 25 minutes of class. The post-test was given during the seventh week of classes. One class was cancelled during the sixth week due to a power failure which turned off the pool maintainance systems as well as the power needed for filming.

Each class period began with an orientation, review, or warm-up section. Students then reviewed videotaped demonstrations, read stroke instructions, or received verbal directions specific to the lesson for that day. Dry land drills were used where applicable followed by shallow water drills, live demonstrations or illustrations, and practice in the deep water tank. Throughout the lessons, verbal cues were given to direct the students' attention to important aspects of the skills.

During the deep water practice, one at a time, each subject demonstrated the stroke or part of the stroke being taught that day. The instructor wrote down individual corrective information at this time and gave this information feedback after all had performed the drill. This drill took approximately five minutes, depending on class size. The experimental group was videotaped in the tank at this time. For the last twenty minutes of class, all classes practiced according to the posted workout schedule. The subjects in the experimental group reviewed their videotaped performance during this time.

The instructor provided verbal feedback to the treatment subjects while they reviewed the films. She provided verbal feedback to the control subjects during the practice phase. The procedure for the tape review was as follows: the instructor called the students in the order they were taped, read or explained the errors that were written down during the deep water swim, and reviewed the tape with the

student, noting the error(s). This procedure took around 45 seconds/student. While each individual reviewed his/her performance, the rest of the class practiced according to the posted workout. The amount of practice time was the same for all classes. The procedure for the controls was similar to that of the treatment group except they did not receive visual feedback. The instructor contacted each student while they were working out in the order that they performed in the deep and read or explained verbally the errors noted previously. This procedure also involved approximately 45 seconds/student.

All classes were taught according the pre-planned lessons. A technician from the Audio-Visual Department of the college operated the videotaping equipment. This person received an orientation from the instructor prior to the beginning of the study. The same technician operated the equipment in all classes. This operator also taped instructional lessons/demonstrations. The natatorium at Calvin College was used exclusively. No other classes were in the pools at the same time as the study groups. Approximately 280 total minutes were spent specifically on the breaststroke instruction, review, and practice, not including testing times.

Dependent Variables

The performance test was chosen to quantify the dependent variable of learning to swim the breaststroke.

Although learning is more permanent than performance, progress in learning a skill may be inferred from the performance of a person in that skill (Drowatsky, 27). The test was based on the assumption that treatment accomodated learning and thus assisted the intermediate swimmer in performing the stroke. The breaststroke was tested as a dependent variable.

Measurement Tools

The experimenter disqualified only those students who indicated inability to meet class requirements such as regular attendance, control of outside practice, and so forth. The questionnaire determined: (a) amount and type of previous swimming instruction, (b) amount and type of previous breaststroke and videotape experience, and (c) willingness to honestly participate in the project. Only students classified for Swim II classes by means of the diagnosis test were involved. This test consisted of twenty-five yards prone and twenty-five yards supine propulsion, ten consecutive bobs, and one minute of survival floating and treading water in the deep tank. The criterion test of entry into deep water identified fear of deep water. A few subjects propelled themselves with poor breaststroke (or incorrect) form, but it was assumed that these subjects had inefficient initial skill and therefore skill attainment could be determined by the differences in the pretest and posttest scores.

The performance test chosen was selected because it met the objectives of the class--i.e., develop an efficient breaststroke. The Kilby stroke count test plus time for the breaststroke provided an objective measure of stroke efficiency. Stroke efficiency reflects sound mechanics. Instruction during the class emphasized mechanics. These mechanics were shown in the good form presented as reference patterns in the lessons. The amount of error correction students were able to make by means of practice with/or without augmented visual feedback was thus measured by this test.

Timing the Kilby test was included because it was believed to be the most reliable and valid means of measurement. Chapman (15) identified three methods of evaluating swimming: (a) the progressive pass/fail skill test, (b) the subjective rating, and (c) the objective performance measurement. The advantage of the objective measure is that it eliminates teacher judgement and can be standardized. When comparing three types of objective tests, Chapman determined that measurement of time and number of strokes while holding distance constant was the most reliable and valid measurement means. She also noted that this type of testing was the easiest to administer. Although her study did not include the breaststroke, she found high reliability using the elementary backstroke (.79) and sidestroke (.83), both of which are glide strokes. Because of these findings and

because the breaststroke is also a glide stroke, the pre-test and post-test used in this study was a timed version of a stroke count test with distance held constant.

The Kilby test is an objective test in which the subject swims twenty-five yards using the breaststroke. Each error the subject commits is counted as one point. The number of strokes required to cover 25 yards plus the number of points added for errors are counted to determine the subject's score. The validity of this test compared with judges' ratings is .76-.78. The reliability determined by two successive trials is .79 (Kilby, 38). Although Kilby did not use time, the time required to swim this distance was also recorded in light of the above findings. The objective of the study and test was to obtain and measure an efficient stroke. To be efficient the next stroke must be inititated before the momentum of the previous stroke is stopped. The time element was not emphasized to the subjects, but was noted to make certain students did not glide until coming to a total stop, resulting in an inefficient stroke. Since the Kilby test did not allow for this factor of efficiency, it was added.

Instrument Calibration

Kilby's test was used with college women. Hewitt (32) used a similar test for college men using a fifty yard distance and a push start. Because the test was used as a pre-test as well as a test of skill attainment, the

twenty-five yard distance described by Kilby was used rather than Hewitt's fifty yard test. Most Swim II students could manipulate themselves in some type of breaststroke motion for twenty-five yards as noted previously. Also the twenty-five yard distance does not measure training effects as much as the fifty yard distance would. Also, the push start might give an advantage to the stronger students.

Hewitt used a twenty-five yard test for high school boys. When comparing three experts' form ratings with the test scores of 124 high school boys, Hewitt (33) found a validity coefficient of .93 ± .03. Kilby's validity coefficients comparing three judges' ratings to the scores computed with errors was .78 (using twenty-four cases). A larger sample might have increased this coefficient.

Test-retest studies of reliability yielded a coefficient of .93 ± .01 for Hewitt's twenty-five yard stroke count and .79 for Kilby's twenty-five yard test. Kilby's coefficient reflects only seventeen cases. Specifications for Hewitt's test are not clear. Since many intermediate swimmers do not initially perform a "correct" stroke, Kilby's method using errors provided a more valid measurement of the range of skill in the pre-testing than Hewitt's test. Kilby noted that error counting is important to the validity of the test. A 25-yard timed breaststroke test has not been tested for reliability, however, Appenzellar (5) obtained reliability of .69 for a sixty yard timed breaststroke test.

Chapman (15) obtained .87 and .84 reliabilities for the sixty yard timed crawl and backcrawl strokes, respectively.

Scoring and Recording Procedures

Standardized directions ensured accurate test administration (see Appendix C). For the test, the swimmers were held on the surface by two assistants, toes two inches from the wall in lane five. The swimmer's feet and upper body were released as the "go" was given and the swimmer began the stroke. Each power phase was counted. Since the flexion of the knees was an obvious indication of the beginning of the power phase, the scores watched for that. As the scores (two working independently) counted strokes, a judge watched the stroke to determine errors, thus making certain the stroke was completed as defined. Errors included: (a) pushing away from the wall on the start, (b) employing propelling motions not deemed part of the stroke, i.e., finning, flutter kicking etc., (c) using an illegal kick or arm pull, or (d) stopping before touching the end wall. A repeated error was counted each time it occurred. The timer began the ten-second watch on the "go" signal and stopped it when the subject touched the opposite wall.

The students were instructed that the objective of the test was to measure efficiency. They were told to glide until their momentum slowed up and then initiate the next stroke. The instructor demonstrated such a rhythm, thus explaining why the time was measured.

Data Collection Procedures

During the second and seventh week of the study, the performance test was given. The posttest was given at a previously arranged special night session. Subjects were randomly assigned to testing times. To avoid the effect of waves on swimming performance, only one subject was tested at a time. The judge and scorers did not know the group identity of the students. Students also were tested in random order for the pre-test.

A score sheet including the student's test number and order was used. The pre-test and post-test scores were recorded on separate sheets, thereby avoiding comparisons. The head scorer served as recorder and recorded the total number of strokes or partial applications of force required to propel the swimmer twenty-five yards. The judge counted an additional one point for each time the performer made an error. The timer assisted the scorers if disagreements arose. The time was recorded to the nearest .10 second. Testing assistants were Physical Education majors who had swimming experience. The same assistants were used for both testings. The number of strokes, the points due to errors, the total points, and the time to the nearest .10 second were recorded.

Treatment of Data

Statistical Analysis

Due to the research techniques and design used in the study, random sample distribution was assumed. The frequency

tables also verified this assumption. Therefore parametric statistics were computed.

The major purpose of this experiment was to study the effects of videotape replay plus verbal feedback contrasted with verbal feedback alone in learning a specific swimming stroke. The current state of knowledge suggested that for this type of skill, videotape feedback would result in enhanced learning. The sample data was collected and basic statistics including mean, mode, median, and variance were computed.

Since it was assumed that learning occurred for all groups, t-tests for differences between initial scores and final scores were run. These determined if significant learning occurred during the study. The major hypothesis for the study was considered--i.e., that the learning of the videotape group was significantly better than that of the control group. To identify this difference, t-tests for significant differences between groups using gain scores were run. The gain score values included stroke count change, error count change, total count change, and time change.

Data Presentation

Tables of the descriptive statistics including means, standard deviations, standard errors, are presented for each separate group and for both groups together in Chapter Four. Inferential statistic tables include the results of the t-tests run for paired observations (i.e.,

pre-test scores compared with post-test scores). The results of the t-tests run on the gain scores are also presented in tabular form.

CHAPTER IV

RESULTS AND DISCUSSION

The study was undertaken to determine whether immediate information feedback via videotape replay would be more effective than traditional feedback methods in learning to swim the breaststroke. While the treatment group immediately reviewed their breaststroke performance through observation of videotaped replay, the control group received only verbal information feedback after their performance. All other instruction and feedback was the same for both games.

This chapter will present descriptive statistics based on the pretest, posttest, and gain score data. The results of the t-tests for significant differences between groups and t-tests for learning effects will then be presented. Finally, a discussion of these results will provide a rationale for the data presented.

Statistical Results

A total of fifty-two subjects began the experiment; however, only forty-seven completed all classes and all tests. Therefore complete data were available for twenty-six treatment subjects and twenty-one control subjects. The Kilby

glide test yielded measurements of three dependent variables: number of strokes; number of errors; and the number of strokes plus errors (count variable). In addition, a measure of the time needed to complete the glide test was obtained. These data were analyzed by means of the SPSS Computor Program for the Social Sciences on the computor at Calvin College.

Descriptive Statistics

The means, standard errors, and standard deviations for all of the pretest measurements are presented in Table 4.1. The statistics were computed for each group.

Table 4.1.--Descriptive Statistics for Pretest Measures

GROUP:	Control Group (N = 21)			Treatment Group (N = 26)		
	mean	standard error	standard deviation	mean	standard error	standard deviation
Number of Strokes	24.905	1.557	7.134	23.385	1.101	5.615
Number of Errors	23.619	2.834	12.986	19.769	2.027	10.336
Count (Strokes + Errors)	48.524	4.071	18.656	43.154	2.852	14.540
Time (sec.)	38.333	2.106	9.651	34.238	1.323	6.745

Pretest measures indicated that the control group as a whole was less proficient than the treatment group. The mean

values of all four measures for the control group exceeded those of the treatment group. In this case, the higher values represent less efficient performance.

Descriptive statistics for posttest performance measures are presented in Table 4.2.

Table 4.2.--Descriptive Statistics for Posttest Measures

GROUP:	Control Group (N = 21 cases)			Treatment Group (N = 26)		
	mean	standard error	standard deviation	mean	standard error	standard deviation
Number of Strokes	19.524	0.963	4.412	18.615	1.067	5.441
Number of Errors	9.381	2.333	10.693	6.654	1.686	8.597
Count (Strokes + Errors)	28.905	2.921	13.386	25.269	2.110	10.761
Time (sec.)	35.905	1.433	6.567	33.704	1.146	5.844

Once again, the control group had the highest mean scores for all the variables, indicating that their performance on the posttest was less efficient than the performance of the treatment group on that test. However, the treatment group showed greater variability in the number of strokes required to complete the glide test as indicated by their higher standard deviation scores.

Examination of the gain scores reveals that the control group improved more than the treatment group in learning the breaststroke (Table 4.3). The greater the mean gain score values for each dependent variables, the more

Table 4.3.--Descriptive Statistics for Gain Scores

GROUP:	Control Group (N = 21)			Treatment Group (N = 26)		
	mean	standard error	standard deviation	mean	standard error	standard deviation
Stroke	-5.381	1.531	7.018	-4.769	0.971	4.950
Error	-14.238	3.020	13.838	-13.115	2.445	12.465
Count	-19.619	3.794	17.385	-17.885	2.852	14.542
Time	-2.443	1.585	7.263	-0.535	0.835	4.257

improvement is indicated. The control group also demonstrated greater variability in gain scores.

Inferential Statistics

After computing the previous sample parameters, t-tests were used to test the hypotheses. Analysis t-test was chosen because the primary purpose of the study was to evaluate the differences between effects rather than to determine the influence of the effects themselves or to determine the interaction of these effects. The tests determined if there was a significant difference in the learning between groups. Since the investigator was also interested in noting whether learning occurred, pretest and posttest scores were also analyzed for significant differences.

The main research hypothesis was that videotape replay with verbal feedback was more effective than verbal feedback alone in aiding college students to learn to swim

the breaststroke. This hypothesis was tested through use of t-tests for gain scores. An alpha level of .05 and a beta level of .20 were set based on the consequences of making a Type I or Type II error. If videotaping was shown to be important in learning, when in fact it was not helpful, schools would be incurring an unnecessary expense. If, on the other hand, it was thought not to be helpful when in fact it was, the consequences would not be extremely detrimental. With these probabilities, the value for rejecting the null hypotheses was $t \geq 1.68$.

Equality of variances was checked by determining the F values (ratio of variances) for the four score variables (Table 4.4). The F values for count change and error change

Table 4.4.--F Values for Gain Scores

Variable	F value	Probability
Stroke change	2.01	0.0495
Error change	1.23	0.3065
Time change	2.91	0.0065
Count change	1.43	0.1970

indicated these variables had equal variance whereas the stroke change and time change F values indicated unequal variance. T-tests using pooled variance estimates were used where variances were equal. The Cochran Cox t-test of separate variance estimates was used to determine significant

differences between means for the variables which had unequal variances (Table 4.5).

Table 4.5.--T-tests for differences Between Groups

Variable	df	T value	Probability
	T-TESTS WITH POOLED VARIANCE ESTIMATES		
Error change	45	0.29	0.3855
Count change	45	0.37	0.3555
	COCHRAN COX TEST		
Stroke change	34.81	0.34	0.3690
Time change	30.75	1.07	0.1475

The results of the tests for differences between groups indicated that the null hypotheses could not be rejected. Consequently the power of each of the tests was computed to determine the ability of these test measurement means to detect a false null hypothesis. The power values for the four variables are presented in Table 4.6. These

Table 4.6.--Power for Dependent Variables

Variable	$1 - \beta$
Stroke change	.9515428
Error change	.9505285
Time change	.9554345
Count change	.9505285

values indicate that the null hypotheses must be accepted at the $1 - \beta$ level of confidence. Thus, videotape replay did not result in sufficient differences between scores of

the treatment and control groups to justify its effectiveness as a teaching technique.

Having noted these results, the investigator was also interested in determining whether learning had occurred. To determine if significant learning occurred within each of the groups, t-tests of paired observations--pretest scores of subjects compared to their posttest scores-- were performed for the separate groups (Table 4.7). For these tests

Table 4.7.--T-Values of Learning Effects for Dependent Variables.

GROUP:	Control Group		Treatment Group	
	t value	probability	t value	probability
Stroke	3.51	0.001	4.91	0.000
Error	4.72	0.000	5.36	0.000
Count	5.17	0.000	6.27	0.000
Time	1.54	0.70	0.64	0.264

the null hypotheses that there were no significant differences (.05 level) between the posttest means and the pretest means or that the differences were in a negative direction--the subjects did not perform as well on the posttest variables for both groups--were tested. The null hypotheses were rejected for a t value $\geq$ 1.68. The subjects improved on all variables except time. Improvement in strokes, errors, and total count was found at the 100 percent level of confidence. The null hypotheses for these variables were therefore rejected and the alternate

hypotheses that there was improvement from the pretest to the posttest measurements were accepted at the 95 percent level of confidence. The null hypothesis was accepted for the time variable.

A review of the raw data helps explain the results presented in tables 4-1 to 4-7. Table 4.8 indicates those

Table 4.8.--Frequency of Posttest Score Increases for the Variables

GROUP:	Control Group	Treatment Group
Strokes only	1	1
Errors only	0	0
Time only	5	7
All the above	2	0
Errors and time	1	0
Strokes and time	0	1
Strokes and errors	0	1

variables in which an increase was found in a subject's posttest scores when compared to the pretest scores. An increase in scores signifies a decrease in performance. It can be noted that the time variable had the largest number of higher posttest scores, showing a loss of proficiency. This is consistent with the results obtained with the t-test for learning effects. Students did not significantly improve in time scores during the study.

Discussion

The purpose of the study was to analyze the effectiveness of videotape replay in learning to swim the breaststroke. A treatment and a control group of subjects provided the data from which the comparisons were made. Both groups were taught by what was considered to be a traditional approach including affective and technique feedback. The attempt was made to teach both groups in a conventional manner with the only difference between groups that one of the groups viewed videotape replay of the breaststroke performance almost every lesson. The results indicated that both methods were effective if technique measurements were used, but that they were not significantly effective in improving swim time. However, the results also indicate that teaching with videotape replay was not more effective than teaching by traditional means. This was true for both the technique and the time variables.

Learning Effects

The results of the study do not refute the generalization that feedback is necessary and helpful in teaching swimming skills. Both groups were given information feedback. The control group subjects were informed verbally of their errors while the errors of the treatment subjects were shown and verbalized to them. A study of the effectiveness of feedback (or some method of feedback) compared to no feedback would have had to include a comparison group which

received no feedback of any type. This would be very difficult in a field setting and would have most likely necessitated involving volunteer subjects.

The study did show that these methods of feedback were effective in teaching swimming technique. The question of whether one method of providing error information is superior to another method remains unanswered. This question will be discussed further in the next section. What is communicated by means of feedback seems to be more important than the method of communication. It may be possible for students to learn from one teacher no matter what methods are used while learning less from another teacher who uses a variety of methods. The results of this study coincide with Taylor's recommendation that it is the manner in which feedback is used and not whether or not it is used that is significant (Taylor, 65).

Subjects will improve their performance in the elements of a task for which they receive specific information (Stallings, 70). At no time during the present study was speed emphasized as an objective. In fact, students were told that the class objective was not to produce competitive swimmers, but to develop skill efficiency. This is not to imply that speed and efficiency are mutually exclusive, but rather that the process in becoming efficient is not necessarily the same as the product of efficiency. All class objectives dealt with the improvement of swimming technique: All information feedback to the learner was

concerned with this goal. Significant improvement in the technique measurements indicated that the objective of feedback is more important than the means of feedback in this group of subjects.

Another implication of these findings is the importance of evaluation methods in determining learning. Since the improvement of subjects is task specific, the measurement tool should reflect the level of specificity that was present in the teaching situation. Carre (14) found that form and distance measurements correlated significantly in evaluating discus throw skill learning. However, he used separate tests to evaluate each of these. The fact that several subjects regressed in performance on the time variable coincides with Del Rey's observation that in a certain environment, speed is sacrificed for accuracy (Del Rey, 23). Possibly the subjects who perceived that the test objective was stroke and error count reduction increased their performance time. Those who perceived time as the objective, decreased performance time but increased their stroke frequency from the pretest to the posttest. Therefore, it would appear that after the objective for instruction is determined, the method of measurement should coincide with the objective. If product is emphasized, speed or distance measurements should be used. If the process is emphasized, form or technique measurements should be used.

Differences between Methods

The results of this study suggest that as long as sufficient error information is provided, videotape replay is unnecessary. This is not consistent with the results of Taylor (65) and Morgan (45) who found videotape with verbal cues to be superior to verbal cues only. Bell (7) also determined that visual information was more helpful than verbal information in improving performance. However, Lockhart (42) suggested that verbal feedback may be helpful in later stages of learning. Possibly this is why it was effective with the intermediate swimmers of this study.

As noted in Chapter II, level of skill has been shown to affect the benefits that can be derived from various kinds of feedback. Most of the intermediate swimmers in the present study had some conception of the breaststroke techniques. For some students it was a matter of improving their mechanics, for others it was a matter of learning the mechanics of the breaststroke. However, some students had to change old habits. For example, a scissors kick is an incorrect breaststroke kick (it counts as an error when performed in the glide test). Initially four of the control subjects and eight of the treatment subjects used a scissors kick. It was observed that throughout the study, subjects who used an improper kick (scissor) had great difficulty substituting another kick for it. Subjects who used an

inefficient kick or did not kick at all were more successful in learning the whip kick then those who used the scissors kick. This might have been because persons using the scissors kick had overlearned the breaststroke while using the kick while the others could not perform efficiently enough to perform the stroke. They most likely did not swim the stroke frequently because of their ineptness. The swimmers using the scissors kick had to break their habit and therefore had to reorganize their skill plan as well as identify new and different neuromuscular pathways.

Many of the subjects using the scissors kick initially (and therefore being charged with errors) did not relearn the whip kick in the time allowed in the study. Because there was a greater proportion of such students in the treatment group, this may have masked the effects of the videotape feedback. It was also observed that once these students observed their error--i.e. scissors kicking--they were cognizant of it. They did not need continual visual feedback of the error as much as they needed cues to help them overcome the fault. This again reflects the fact that the mere provision of feedback may not be enough to change performance of a complex task (Taylor, 65). Apparently, as with repeated model showings, the subject does not need to constantly see an error. Once the subject is cognizant of the proprioceptive cues concerning the error, repeated showings of the same error was not necessary. This is

consistent with the suggestion that repeated observations of errors can be disturbing (Cratty, 21).

Another explanation of the results of the study in relation to the effectiveness of videotape replay compared to verbal feedback only is that the treatment group as a whole was initially more skilled in the breaststroke than the control group. Students who are more skillful at a task have less potential improvement to achieve than students who have little or no skill. Because of this initial difference between groups, the final differences may not correctly indicate feedback effects. The fact that the treatment group gain scores in general were lower than the control group gain scores reflects this concept that the more skillful group had less to learn.

Thus, the question concerning at what level of skill or stage of instruction would videotape replay be more effective is still left unanswered. Part of the reason for this dilemma is the vagueness of the concept of skill level. It can be generally accepted that beginners are those who are attempting a novel skill. Beyond that, level is an arbitrary term. Lloyd (41) inferred stages of learning based on amount of previous instruction by exposing groups to treatment after a specified number of weeks of the instruction had passed. He found that viewing one's performance during the middle stages of instruction hastened learning. He also determined skill level by dividing the groups into thirds. This division is dependent on the total range of

skill within the initial group. Taylor (65) referred to levels of skill in this latter sense as dependent on judges' ratings. Thus, when inferring at what level of skill videotape may be helpful, one could look at the stage in the instructional process or at the skill level of subjects based on some comparison criteria. In the present study, subjects were classified as intermediate swimmers based on a standard set by Calvin College. However, within that category there were students for whom the stroke was a new experience (beginners); students for whom part of the stroke was new (advanced beginners) and students who had been exposed to the instruction and/or practice of the technique, (intermediate or advanced swimmers). To draw any conclusions concerning skill level and feedback from this study is thus a questionable undertaking.

One other facet concerning the results is the amount of time spent in the study. It might be possible that videotape feedback hastens learning. However, since the study involved many hours of practice this possibility may have been masked. The appropriate amount of time spent in practice may be the reason why Morgan (45) and Plese (52) obtained significance differences between their group of study groups. Their studies may have been long enough or short enough for existing differences to emerge as statistically significant findings. Taylor (65) may not have allowed enough time or may have allowed too much time for

differences to be noted. This reinforces Robb's statement that there is no optimal schedule of practice time for learning a given task. Further study is needed to determine if videotape replay review can speed up the learning process.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of the study was to investigate the effectiveness of videotape replay as a means of providing information feedback to subjects learning to swim the breaststroke. Forty-seven students enrolled in four intermediate swimming classes served as subjects. The classes were randomly assigned to treatment or control groups. The Kilby glide test plus time was administered during the third class meeting. All classes were instructed in the mechanics of swimming and various swim techniques as well as the breaststroke according to previously planned lessons. Lessons included instruction, drills, and demonstrations. During the second half of each lesson subjects performed a prescribed drill in the deep water tank. Treatment subjects were videotaped at this time. Following this drill, subjects began swimming instruction according to a prescribed schedule of activities. The treatment subjects individually reviewed their videotaped performance during the workout

period. Subjects in the control group were given only verbal feedback concerning performance errors during the workout stage.

During the seventh week, the Kilby glide test plus time was again administered at a special evening test session. Students from all classes were randomly assigned a testing time. The test required the subjects to swim the breaststroke for 25 yards. Measurements of the number of strokes, the number of errors, the number of total strokes and errors (count), and the time required to swim this distance were recorded. Descriptive and inferential statistics were applied to these measures. Determination of group differences was achieved through the use of t-tests. Similarily, t-tests were used to determine if learning occurred in either group.

Summary of Results

The following results were obtained from the study:

1. The treatment group had lower mean and variance scores than the control group on all pretest variables (strokes, errors, time, and count).
2. The treatment group had lower mean and variance values than the control group on all posttest variables, except strokes.
3. The treatment group gain score mean and variance values were lower than the control group gain scores for these variables.

4. Both groups improved in performance on all the dependent measures. However, the smallest improvement occurred in the time variable.
5. There was no significant difference in gain scores between the control and treatment groups on the four measurement variables (χ = .05).
   a. There was no significant difference in gain scores between the control and treatment groups in the stroke change variable.
   b. There was no significant difference in gain scores between the control and treatment groups in the error change variable.
   c. There was no significant difference in gain scores between the control and treatment groups in the time change variable.
   d. There was no significant difference in gain scores between the control and treatment groups in the count change variable.
6. Significant learning occurred in the stroke, error, and count variables. However, there was no significant learning effect for the time variable (α = .05).

Conclusions

The following conclusions were drawn from the results of the study:

1. The treatment group more highly skilled in breaststroke, initially. Lower scores on the pretest indicated better performance by this group.
2. The treatment group was superior to the control group after the instructional phase of the study--i.e. on the posttest measurements.
3. The treatment group improved less than the control group on all the variables. The lower gain scores represented less improvement.
4. In general, the subjects in both groups improved from the pretest to posttest indicating that learning occurred in the stroke change, error change, and count change variables.
5. The difference between the posttest and pretest scores in time for both groups indicated that the improvement in this variable was due to chance. In fact, sixteen subjects increased in the time variable.
6. The two groups' gain score statistics were sufficiently similar on all variables to conclude that videotape replay was not a more effective means of feedback than verbal feedback in learning the breaststroke.

Recommendations

The following recommendations are made based on the previous discussion and conclusions:

1. Studies in this area replicating this study be undertaken with the following variations:
   a. inclusion of an additional control group receiving no extrinsic error feedback;
   b. separation of time and technique tests. Students would be informed of these different objectives and thus know the basis of the test. Correlations between these measurements could then be made;
   c. elimination of variability in initial skill level by ommiting all students who performed without errors or who performed below a given standard initially; assuring that all subjects would be at the intermediate skill level;
   d. inclusion of frequent testing to determine how efficiently and quickly subjects learned the skill;
   e. accounting for sex ratios in each group.
2. A study be undertaken to answer some of the problems concerning learning raised in this study by:
   a. isolating error information feedback modes and combinations of these modes to determine the most effective source of feedback;

b. comparing the amount of time required to relearn a skill as opposed to learning a novel skill.

3. Studies continue to be undertaken to determine which techniques of videotape are more effective including the effectiveness of camera positioning for skill analysis of swim strokes.

APPENDICES

APPENDIX A

SWIM QUESTIONNAIRE

APPENDIX A

SWIM QUESTIONNAIRE

Name:_____

Sex_____Year_____

Age____Ht.____Wt____

A. Swimming experience

1. Have you ever taken swimming lessons before?_____

   a. If so, describe:

      1) How long ago?
      2) Type of instruction (i.e. Red Cross, camp, YMCA, etc.)
      3) Approximate time spent in lessons (i.e. 2xs per week for 5 wks., etc.)
      4) Final Level of attainment (e.g., passed beginners, etc.)

2. How often do you now go swimming? Where do you swim?

3. Have you ever received any type of instruction in how to swim the breaststroke? Explain:

   a. Type and time of instruction (e.g. a life guard during open swim yesterday, etc.).
   b. Where taught:

4. Have you ever attended or been in a swim meet?_____

   Explain (where, when)

5. Describe a breaststroke as you conceive of it: How far do you think you can swim it?

B. Miscellaneous:

1. Why did you take this class?

2. If you miss any classes during the session, would you be able to make them up on Friday at this time? or come at designated time?_____

3. Are you afraid of water?

   Can you swim in the deep without fear?

4. Have you ever been videotaped before--if so, describe your experience.

5. How would you feel about televised instruction?

6. In order to make this study meaningful, the following requirements are necessary. Indicate by signing below if you will be willing to participate and meet these requirements:

   a. Do not discuss the study outside of class.
   b. Practice or do not practice outside of class as directed by the instructor.
   c. Attend class regularly--make up all missed classes as soon as possible.
   d. Be on time to class.

Signed_____

C. Describe each of the following strokes and indicate how far you think you could swim each now:

Crawl:

Sidestroke:

Backcrawl:

Elementary backstroke:

APPENDIX B

OUTLINE OF LESSON ACTIVITIES

APPENDIX B

OUTLINE OF LESSON ACTIVITIES

Day I
A. Introduction: i.e. roll, class time, dressing procedure, pool rules

B. Class objectives:

1. Skill proficiency
2. Fitness

C. Grading

D. Study
Questionnaire

Day II
A. Procedures orientation/explanation

B. Water orientation

1. Deep water
check for fear--survival floating

2. Shallow
check stroke development

Day III
A. Test--Kilby glide test plus time (Appencix C)

B. Mechanics--handout

1. Go over handout
resistance--streamlining
propulsion--Newton's third law
pull--bent arm
evenness of application of force

2. Films--videotape of instructor doing strokes with application of principles described above

3. Practice--apply principles to crawl pull, prone positioning

Day IV

A. Breathing Practice

1. Bobbing
2. Rotating head to side
3. Head and arms coordination
4. Head lift--jellyfish

B. Practice in deep
film rhythmic breathing while jellyfish floating--
orient to deep drills--order, filming procedures for treatment

C. Workout done in shallow pool as indicated
Bob across pool and back 50 yards
swim crawl with breathing--50 yards-100 yards
jellyfish position--in deep tank, jellyfish float with rhythmic breathing 5 min.

Day V

A. Instruction in whipkick

1. directions
2. videotape
3. deck practice
4. demonstration in water
5. side brace practice
6. swim 1 width

B. Deep water drill

C. Workout

1. Rhythmic breathing
Bob 15 times consecutively
walk 25 yards breathing to side
walk 25 yards breathing with head lift

2. Whip kick
10 braced to side, rest, 15 kicks, rest, 20 whip kicks, rest. (20 sec. rests)
swim 50-100 yards using whip kick and kick board--rest 2 minutes
swim 25-50 yards of whip kick without kick board

Day VI
A. Review whip kick

1. re-read hand out directions
2. dry land drill
3. side drill
4. 50 yards with supervision
5. relay

B. Deep water drill

C. Work out

1. Rhythmic Breathing:
   bob 20 times in a row
   walk 50 yards doing crawl breathing and arms--work on rhythm and relaxing
   breaststroke breathing--head lift--20 times in a row

2. Breaststroke
   wall--15 kicks, rest, 20 kicks, rest, 25 kicks, rest, 30 kicks, rest. (20 sec. rest)
   50-100 yards of kick only
   50-100 yards of kick only--count number of kicks for best 25 yards

Day VII
A. Arm Pull

1. Explain
2. Practice on land
3. elbow drill--forearm force drill
4. view videotape--of instructor
5. 2 widths with correction--partner hold feet

B. Deep water drill

C. Workout

1. 25 bobs
2. Wall work: 20 whip kicks, rest (20 sec.) 25 kicks, rest, 30 kicks, rest
3. Partner holding hands--kick for 25 yards
4. 50 yards of arms only while walking
5. Partner hold feet--25 arm pulls, hold partner, repeat
6. 50-100 yards of arms only

Day VIII
A. Breathing and coordination

1. dry land drills with breathing
2. 2 widths using arms and breathing--1 walking, 1 swimming--correction
3. Demonstration of coordination
4. verbal cues--1 width--"pull", "kick", "glide"

B. Deep water drill

C. Workout

1. Walking--(50 yards) doing arm pull and breathing
2. partner hold feet--arm pull and breathing--50 yards
3. whip kick on wall--25 kicks, rest (20 sec.), 30 kicks, rest, 35 kicks, rest
4. Total stroke for 50-100 yards working on coordination
5. Count how many glides it takes to swim 50 yards

Day IX
A. Water entries
stride jump into deep
approach and jump off board
dives

B. Deep Water Drill (looking at coordination)

C. Workout

1. Breaststroke
50 yards of whip kick only
50 yards of arm and breathing only
100-150 yards of coordinated breaststroke

2. Crawl--250-300 yards

Day X
A. Racing dive
from shallow side
from raised side
from blocks

B. Relay--50 yards of breaststroke

C. Review breaststroke kick

1. on deck
2. demonstration

D. Deep water drill

E. Workout
50 yards of breaststroke--rest 30 seconds
50 yards of breaststroke--rest 30 seconds
50 yards of breaststroke--rest 30 seconds
whip kick only on wall--40 times
100 yards of relaxed breaststroke
300 yards of crawl

Day XI
A. Review mechanics of arm pulls

1. crawl--correct extension
dropping elbows
recovery
6 lengths of crawl with breathing

2. Breaststroke--
correct depth--palms facing back
50 yards--25 walking, 25 with legs
coordination, breathing exercise

B. Deep water drill

C. Workout
75 yards of breaststroke--rest 1 min.
75 yards of breaststroke--rest 1 min.
75 yards of breaststroke--rest 1 min.
50 yards walking doing arms and breathing only
hold partner's feet, partner does arms and breathing for 25 yards--switch
30 whip kicks on wall
100 yards of breaststroke--if time 300 of crawl

Day XII
A. Review whole stroke
1 width of legs only; correction
1 width of arm pulls while walking--correction
1 length of arm pulls while walking--with breathing--correction
1 length of entire stroke--corrections

B. Deep Water Drill

C. Workout
1 bout of 25 kicks on wall
100 yards of breaststroke working on timing--rest 1 min.
in place, 25 arm pulls with breathing
1 bout of 25 kicks on wall

100 yards of coordinated breaststroke--1 min. rest
in place 25 arm pulls with breathing
1 bout of 25 whip kicks on wall
100 yards of coordinated breaststroke
if time: 200 yards of breaststroke, 350 yards of crawl

Day XIII
Special night session
Final Kilby glide test plus time administered--subjects came in order determined by randomization

NOTE: Day XI lesson was postponed due to sleet storm that caused power failure.

Original plan was for 14 lessons.

APPENDIX C

TIMED KILBY STROKE

COUNT TEST

APPENDIX C

TIMED KILBY STROKE

COUNT TEST

A. TESTING PROCEDURE:

1. Roll

2. Test orientation:

Tester says: "today we are going to test the breast-stroke. The test includes counting the number of strokes you take and how quickly you can swim across the pool. You must perform a stroke which includes one arm pull, one kick and one breath for each stroke. Please read the directions that were handed out to you and ask any questions you might have."

Allow subjects time to read directions and read stroke regulations out loud.

Demonstration of stroke.

Reread directions and regulations.

3. Testing procedure:

Testing order is posted.

B. STANDARDIZED DIRECTIONS:

Directions to Assistants--

Leg holder: Hold the students' legs at the knees and and ankles. Make sure the toes are 2 inches from the wall. Let go when the starter says "go." Do not push the performer.

Midriff holder: Cradle the student's stomach in your outstretched arms. The student should be held in a comfortable position on the water. On "go" drop your arms away.

Directions to Timer: On signal start the 10 sec. stop watch. Stop the watch as soon as the performer touches the wall. Record to the nearest tenth of a second. Note--use index finger to start the watch.

Direction to Scores: On signal the swimmer will begin the stroke. Count the power phase of each stroke. The power phase includes one arm pull and one kick. Watch knee flexion for an indication of the power phase. Count each stroke until the performer touches the wall 25 yards away.

Directions to Judge: On signal watch the performer's stroke. Count one point for each error. Errors are: (a) pushing away from the wall, (b) employing additional propelling motions such as finning, flutter kick, etc., (c) using an illegal kick or arm pull, (d) stopping before touching the end wall. To be legal the stroke must include 1 arm-pull and 1 leg kick, and some portion of the head must break the surface before the next stroke. (See Stroke Regulations)

Directions to the Recorder: Record the scores of both scorers. If there is disagreement--determine which scorer is correct (you count score too). Record point errors from judge uners "errors," record totals. Record time to nearest .10 from timer. Make sure you have the correct name and swim order of each swimmer.

Directions to the Swimmers: Lie in a prone position with your toes barely touching the wall. Another person will hold your feet 2" from the wall; another person will hold your tummy up. On "go" begin your stroke. Swim the breaststroke across the pool as I have demonstrated. Do not touch the bottom or stop. Do not flutter kick or use any other kick than the one

I demonstrated. Your arms must stay underwater. Breath every glide. On "go" the watch will be started and it will stop as soon as you touch the wall on the other side. We will record your time and the number of strokes it takes you to get across the pool. Everytime you touch the bottom, do extra kicks or use illegal arm pulls or kicks, you will get extra points. Try to do your best stroke--remember: one arm pull, one kick, and one breath per stroke.

Stroke regulations:

"One arm-pull and one leg-kick may be taken underwater. Some portion of the swimmer's head must break the surface of the water before another stroke is started.

Both hands shall be extended forward simultaneously on or under the surface of the water and pulled back simultaneously.

Both shoulders shall be kept on the horizontal plane.

The feet shall be drawn up simultaneously, movement continues in a rounded outward sweep of the feet, bringing the legs to full extension behind the body."

Keep legs on the horizontal plane (DGWS, 25).

C. RECORDER'S FORM

Date:

order	number	score	errors	total points	time

Recorder_____ Scorers:_____ Timer:_____

_____ Judge_____

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