AN ABSTRACT OF THE THESIS OF

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Title: A COMPARISON OF TWO GROUPS OF NON-SWIMMERS TO DETERMINE LEARNING DIFFERENCES WITH THE USE OF BIOFEEDBACK MUSCLE RELAXATION TRAINING

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Purpose: The purpose of the study was to investigate the difference in learning swimming between two groups of non-swimmers, one participating in electromyograph biofeedback muscle relaxation training and the other without muscle relaxation training.

Method of Research: Thirty-four subjects who were classified non-swimmers and enrolled in elementary swimming classes were used to test the hypothesis. Each of the thirty-four subjects completed the American Red Cross beginning and elementary backstroke skills pre and post tests, plus the

appropriate subjects completed eight weeks of biofeedback training in muscle relaxation. The performance scores from the swimming tests were utilized as the data. To determine statistical significance at the .05 level *t*-tests were used.

Conclusions:

(1) The two groups did not differ significantly in the learning of beginning swimming skills, but both groups did learn beginning swimming skills.

(2) Subjects trained in electromyograph biofeedback muscle relaxation did display a slight difference in learning on the tests requiring skills on the back.

(3) Number of subjects was too low to obtain significant differences in learning.

(4) Experimental subjects' responses indicated that biofeedback training did facilitate their ability to relax.

A COMPARISON OF TWO GROUPS OF NON-SWIMMERS TO DETERMINE LEARNING DIFFERENCES WITH THE USE OF BIOFEEDBACK MUSCLE RELAXATION TRAINING

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T. C. B.

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Chapter 1

INTRODUCTION

This chapter discussed information regarding the difference in the learning of beginning aquatic skills by two groups of non-swimmers, one participating in electromyograph biofeedback muscle relaxation training and the other with no muscle relaxation training. The theoretical formulation, statement of the problem, the null hypothesis, significance of the study, and the assumptions of the study have also been presented. The limitations and delimitations have been included along with clarification of terms.

THEORETICAL FORMULATION

Basmajian (6) theorized that motor learning is a process of inhibiting unwanted and unnecessary motor neuron firing. He believed that relaxation is a motor skill in itself because the ability to reduce muscle neuron firing is as important to motor learning as is the generation of motor neuron firing. Relaxation then must be considered an important ingredient to motor learning and skill acquisition. Haverland (41) in her study dealing with muscle relaxation and skill acquisition demonstrated that progressive relaxation training did significantly affect the reaction time and smoothness of motor skills.

However, the research on EMG biofeedback training in muscle relaxation related to skill performance is very limited. Stoyva and Budzynski (71) examined muscle relaxation training on tasks of complex decision making and simple sensory motor activities. The hypothesis tested was whether or not subjects trained in muscle relaxation would perform better than subjects who lacked such training. The investigation found no significant difference of performance in any of the activities. Chaney (22) tested subjects trained in muscle relaxation and those who lacked training by using a motor skill (throwing darts) and a mental test (memorizing random numbers) under induced tension. The study demonstrated that subjects trained in muscle relaxation performed significantly better on the mental task. There was no significant difference between groups on performance of the motor skill.

All of these investigations dealt with specific aspects of muscle relaxation training, but not EMG biofeedback muscle relaxation training and the acquisition of a motor skill associated with a particular sport. Could muscle relaxation training assist an individual in learning a sport skill? The significance of muscle relaxation and the acquisition of sports skills thus far has not been answered. Therefore, further investigation needs to be pursued.

THE PROBLEM

The fear or threatening element of water can cause large amounts of tension and thus affect the learning of aquatic skills. Fredrick (30) stated that motor skill acquisition is facilitated by relaxation. Jacobson (45) showed that an individual cannot be simultaneously tense and relaxed.

Taking the above statements into consideration, could relaxation training assist a relaxed individual to achieve greater levels of aquatic skill? More specific can EMG biofeedback relaxation training assist an individual in learning swimming skills? Could students exposed to relaxation techniques use those techniques while working in the water? At what skill level is relaxation training most beneficial--beginning, intermediate, or advanced? It was on the basis of these unanswered questions and the lack of research that the following problem was tested.

Statement of the Problem

Is there a significant difference in the learning of beginning aquatic skills by two groups of non-swimmers, one participating in electromyograph biofeedback muscle relaxation training and the other with no muscle relaxation training?

Hypothesis of the Study

The null hypothesis was tested to investigate the above problem:

There is no significant difference in the learning of beginning aquatic skills by two groups of non-swimmers, one participating in electromyograph biofeedback muscle relaxation training and the other with no muscle relaxation training.

Assumptions of the Study

The following were assumptions of the study:

1. The subjects tested put forth their best effort while performing the American Red Cross beginning skill test and the elementary backstroke test.

2. Subjects tested did not participate in extra swimming practice.

3. Subjects being trained in muscle relaxation used that training while learning and practicing swimming skills.

4. The validity and reliability of the American Red Cross beginning and elementary backstroke skill tests were significant enough to be used as measurement of beginning swimming skills.

Purpose of the Study

The purpose of this study was to investigate the difference in learning of beginning aquatic skills by two groups of non-swimmers. The subjects went through eight weeks of swimming instruction plus one group also received

EMG muscle relaxation training. The difference in learning was evaluated from a comparison of pre and post test performance scores.

Significance of the Study

Jacobson (30) indicated that physical education should be an education of the body and the mind. Implications from biofeedback research show that biofeedback training could lead education to a holistic education, an education of body and mind. Steinhaus (76) believed that neuromuscular relaxation training in physical education classes can influence this body/mind concept. There has been no conclusive evidence that with the assistance of biofeedback training physical education will be holistic or a mind/body education; therefore, there was a need for further research in the use of biofeedback techniques in the field of physical education.

Educators are now asking, what about educating internal physiological processes (24) by including biofeedback relaxation training in the physical education curricula (50). "Neuromuscular relaxation . . . is a worthy addition to the armamentarium of physical education (76:11)." Only further investigations dealing with biofeedback training in the field of physical education may provide insights into the benefits of teaching internal physiological control during physical education classes.

The limited research done with EMG biofeedback muscle relaxation training and the acquisition of sports skills seems to indicate that this study has merit and is justified. The results of this study might improve teaching techniques for teachers and coaches involved in helping individuals to learn sports skills, especially swimming.

DEFINITION OF TERMS

The meanings of terminology relevant to this study are discussed below.

American Red Cross Beginning and Elementary Backstroke Skill Tests

Battery of thirteen tests designed to test beginning swimming skills. (Appendix A, page 64)

Beginning Swimming Skills

Beginning swimming skills are defined as muscular movements or motions of the body required for the successful execution of specific motor acts in water as described by the American Red Cross. (Appendix A, page 64)

Biofeedback

> Biofeedback is defined as the use of a monitoring instrument to detect and amplify internal physiological processes within the body, in order to make this ordinarily unavailable internal information available to the individual . . . (8:362)

Differential Relaxation

Differential relaxation is defined "as the efficient use of only those muscles that are required in the performance of motor skills (30:27)."

Electromyograph

Instrument used to detect and amplify electrical activity within a muscle (64).

Electromyogram or EMG

The electrical activity within the muscle is called electromyogram or EMG (64).

Electromyograph Feedback

Electromyograph feedback is recording the EMG activity and giving it back immediately to the individual by visual or audio displays (64).

EMG Biofeedback Relaxation Training

This term refers to training in the use of the Autogen 1500 electromyograph. During the training the individual received visual or audio signals of muscle contractions. By training with the biofeedback instrument the individual will learn voluntary control over muscle contractions; therefore, a state of relaxation will be achieved.

Feedback

In this study, feedback was a report of biological results (muscle contractions) so that biological behavior (muscle relaxation) could be achieved (28).

Frontalis Muscles

"The frontalis muscles arise from the aponeurosis and inserts into the skin in the region of the eyebrows (21:120)." The frontalis muscles are the ones which raise the eyebrows and wrinkle the skin on the forehead.

Learning

"Learning is a relatively permanent change in performance or behavioral potential resulting from practice or past experiences in the situation (73:10)."

Measurement of Performance

In order to determine what amount of learning took place, a measurement of performance is necessary (27). This term refers to beginning swimming skills performance scores on the American Red Cross Beginning and Elementary Backstroke pre and post tests.

Motor Learning

"Motor learning was the acquisition and performance of behaviors that are reflected by movement (73:13)."

Non-Swimmer

Any individual who could not pass the American Red Cross beginning and elementary backstroke skill tests and was enrolled in the elementary swimming classes during the 1979 fall semester.

Relaxation

Total rest or deep relaxation of all the muscles of the body (30). Specifically for deep relaxation the electromyograph should read .5uv or below (64).

Volition

Involved allowing certain responses to come forth rather than making them come forth (77).

LIMITATIONS OF THE STUDY

The following were limitations of this study:

1. Data presented in this study was obtained from students who were identified as a normal population, so that any conclusions which can be made from this study must be restricted to predictions for normal students.

2. The investigator had no control of extra swimming practice or drop out rate of biofeedback subjects.

3. The sample of forty was small to work with statistically. Therefore, the comparisons, taking into account degrees of freedom, will be statistically less significant than might be expected from a larger sample.

Delimitations

The following were delimitations of this study:

1. The college students involved in this study were only those enrolling in two of the elementary swimming classes offered at Emporia State University during the 1979 fall semester.

2. Only subjects enrolling in the elementary swimming class and classified as non-swimmers were tested. Subjects were classified non-swimmer if they could not pass the American Red Cross beginning and elementary backstroke skill tests. The American Red Cross gives specific standards for passing each of the battery of skills. (Appendix A, page 64)

3. Swimming skills taught were limited to beginning swimming activities approved by the American Red Cross.

4. Subjects involved with EMG biofeedback muscle relaxation training used only the Autogen 1500 machine.

Chapter 2

REVIEW OF RELATED LITERATURE

This chapter is divided into four sections. The first section focuses on the foundations for understanding skill acquisition. Models of how motor skills are learned are presented in the second section. Section three discusses the relationship of emotions and their association with motor skill learning. The last section covers biofeedback, relaxation training, and the relationship that now exists between EMG biofeedback and physical education.

The premise of this study was that the learning of beginning swimming skills by non-swimmers would be facilitated by EMG biofeedback muscle relaxation training. The premise was investigated by an analysis of subjects' performance scores obtained from an instrument designed to measure swimming skills. The review of related literature appeared to support the study of this new premise.

LEARNING THEORIES

Although learning theories are not fully developed or proven, they do provide a better understanding of the learning phenomena. Learning theories are a collection of facts and information. They have explained relationships and allowed deductions to be made from new facts. Because motor skills are learned, learning theories have provided some basis for understanding skill acquisition.

Learning theories are classified into three categories: (1) association, (2) cognitive, and (3) cybernetic (68). Association theories stated that learning was based on the response an organism made and the connection of the response to the stimuli. Cognitive theories stated that learning was based on the perception of the learner in discovering and understanding relationships. The cybernetic theory emphasis was on feedback and how external and internal stimuli were coded and regurgitated into a learned response (68).

Association Theories

Associated theories have been named association, bond, connectionism, trial and error, or stimuli response. Experimenters who contributed to these learning theories included Thorndike, Watson, Guthrie, and Skinner. Association theorists believed that a stimuli always preceded performance and the response was a reaction to the stimuli. In some cases a response was a stimuli for the next response thus causing a chain of events which formed the basis for learning. A reward or reinforcement was introduced following the response. Therefore, association theorists argued the necessity of rewards, but also believed that learning took place when the stimuli and response occurred simultaneously and contiguously (68).

An important phenomenon in association theories was conditioning. Conditioning was classified as classic or operant. In classic conditioning, a response was caused by pairing a stimuli with another stimuli that caused the response naturally. In operant conditioning, when the desired response occurred it was reinforced.

One of the leaders in association learning theories was Thorndike. His laws of learning were based on the principles of the association theory. The law of exercise stated that repetition strengthens the association between stimuli and response; thus, the probability of the response being repeated was increased. The law of effect was concerned with the importance of reward or reinforcement. Responses followed by pleasant outcomes were more likely to be continued. Thorndike believed in trial and error and practice as important factors in learning. His final law was the law of readiness. This law emphasized the importance of the readiness of the learner to learn (73).

Another factor to Thorndike's learning theory dealt with transfer. Thorndike stated that all learning was specific and there was no generalized pattern of transfer (73). Consequently, Thorndike emphasized specific learning in the educational system.

Another prominent leader in the field of learning was Skinner. Skinner was concerned with responses and not the stimuli. In his theory of operant conditioning the response was caused by the individual instead of a stimuli. He advocated that a response followed by reinforcement increased the chances of the response being repeated.

In summary, the main points to the association theories included three principles. First, the establishment of a bond between the stimuli and response increased the chances of the response occurring when the stimuli was presented. Second, learning was based upon a chaining of stimuli-response habits. Third, learning was specific and happened after many corrections and reinforcements (68).

Cognitive Theories

Cognitive theorists believed that learning was a result of organized and perceived experiences. The individual was interacting with the environment, thus reorganizing experiences and gaining insights. Learning took place through insights. The cognitive theorist was interested in the cognitive structure of an individual and what the individual understood (54).

The cognitive theorists believed that an individual must understand a problem before it was solved. They were also very interested in the self-concept of an individual. They emphasized the process of developing an individual's potentialities. Tnerefore, the cognitive theorist believed in a self actualizing process rather than manipulating forces (68).

Transfer of learning took place because of similar patterns. If the learner understood the task and a new task contained similar patterns, the new task could be performed. Cognitive theorists emphasized principles, concepts, and understandings (68).

One of the proponents of the cognitive learning theory was Gestalt. Gestalt believed "the learner perceives meaningful relationships in his environment and gains insights into the understanding and solving of problems (73:63)." The major contribution made by Gestalt to education was the whole method of teaching (73).

In conclusion, the cognitive theories of learning were based on perception. The learner perceived relationships within the environment and gained insights into these relationships to solve problems. Self-concept was very important as well as the self-actualizing process. Transfer of learning took place not because of identical elements, but because of similar patterns.

Cybernetic Theory

Basically cybernetic is defined as "the study of control process and mechanisms in machines and human organisms (73:72)." The cybernetic theory compared each individual to a computer. The theory emphasized each individual was an information processing center much like the computer. The center of the system was the brain which contained an input and output system and a memory compartment.

The processing of information was based on the principle of feedback. The cybernetic theorist believed an analogy existed between motor skill learning and servomechanisms. Servomechanisms were self-regulating devices operated on a closed-loop system of feedback. An individual involved in learning a skill received feedback from past performances which assisted in determining future performances. The cybernetic theorist emphasized skill performance dealt with sensory, perceptual, and effector information (68). Therefore, to the cybernetic theorist motor skill learning was a continuous closed-loop system in which skill performance was an interaction between past performances and sensory feedback on future performances.

Singer stated, "cybernetic theory in general has done more for promoting interest and providing information in motor-skill learning than any other type of theory (73:74)." The research of Smith (68) has done much to support the cybernetic theory. In addition, Adams (73) has supported the cybernetic theory by explaining the closed-loop system of feedback.

In summary, the cybernetic theory was based on continuous sensory feedback of skill performances. The cybernetic theorist emphasized the brain as the information processing center. Through the brain an individual received sensory information on past performances which were then discharged through the output system to assist in future performances. Consequently, the cybernetic theory was concerned with motor skill learning.

MODELS OF SKILL ACQUISITION

In the last twenty years, models have been developed specific to motor skill acquisition (73). Models have aided in the general understanding of theories. There are many different types of models, and some are theoretical, practical, or applied. They do not explain all types of learning but do reflect learning in relationship to skill acquisition.

Fitts (68) described motor skill learning with three models: (1) communication model, (2) control system model, and, (3) composite model. In the communication model the theorist is concerned with information processing activities and coding. In skill acquisition the individual processes information concerning the whole motor skill. The communication model viewed learning as the processing of external and internal information in relationship to the total execution of a motor skill. The coding of information was a concern of the cybernetic theorist. The cybernetic theorist believed that in the communication model the individual received information and coded it into symbols. The information was translated and either stored in the memory or directed to output areas.

The second model was the control system model. "There are two types of control systems, (1) a regulator system and (2) a follow-up system (68:33)." The regulator system was described as a fixed input, much like the temperature on a thermostat control. Once the temperature was set the operation was fixed. An individual has fixed input, such as balance adjustment to different body position changes. A follow-up system, also called adaptive system, has no fixed input. An individual adapts and changes through experiences. Both types of control systems are used as individuals regulate their learning of motor skills.

The third model was a combination of the other two models and was called the composite model. In this model the learning of motor skills was considered

> a composite of communication control, data processing activities, and perceptual qualities allowing skill acquisition to be described in terms of sequence of events, the temporal and spatial patterning, and the feedback function. (68:34)

The composite model allowed the cybernetic theorist to investigate areas such as hierarchical processes, channel capacity for processing sensory information, and feedback loops.

Another interesting model on the analysis of motor skill performance was developed by Henry (73). The memory-drum theory compared motor performance to a computer. Individuals stored specific learned motor skills on a memory drum. When certain stimuli caused a reaction from the neuromotor center, the motor skill was performed. Henry emphasized well coordinated skill was performed at a point just above the unconscious level because it was stored on a motor memory drum. He also indicated only specific skills are stored and similar movement patterns will not cause a reaction from the neuromotor center.

Cratty (73) developed three levels which are general and specific to learning of motor skills. Level one was general factors which included persistence, aspiration, and ability to analyze tasks. Specific abilities were presented in level two, which included speed, strength, and accuracy. The third level was specific factors to a motor skill. Examples of level three included past experiences, practice conditions, social conditions present, and unique movement patterns required by the skill. Cratty tried to make instructors aware of the interactional effects of each level upon the learning of motor skills.

Whiting (73) developed a model of the skill learning process. He demonstrated the relationship of subsystems such as sense organs, perceptual mechanisms, translatory mechanisms, effector mechanisms, muscular system, output, and feedback. His model showed general processes which all individuals used in skill performance plus individual differences and environmental influences. His model also reflected other factors influencing motor skill learning, such as selective attention, arousal, and decision making.

RELATIONSHIP OF EMOTIONS TO SKILL ACQUISITION

A factor specific to this study was the relationship of emotions to skill acquisition. "Emotions are psychological and physiological responses and reactions resulting from perceived situations (73:278)." The term emotions conveyed a conscious feeling-pattern change and a physiological-chemical change. Emotions are involuntary and play a vital part in motor skill learning, whether caused by the skill, the environment, or the mind of the learner. For example, fear (an emotion) is considered a deterrent to learning especially in fear-inducing sports, such as swimming, diving, gymnastics, and trampolining (73).

Particular types of emotions, such as stress, tension, and anxiety have been defined and reported in physical education literature. Stress has been defined as "the efforts of the body to recover from generalized upset of imbalance in its normal equilibrium or homestasis (54:121)." Tension has implied bodily unrest and nervous reactions to situations. Anxiety has been reported in two types, trait and state. Trait anxiety is described as a personality trait which predisposes an individual to perceive certain situations as threatening. State anxiety is characterized as "subjective, consciously perceived feelings of apprehension and tension, accompanied by or associated with activation or arousal of the autonomic nervous system (75:17)." How do all these emotional factors reported in physical education literature affect learning of a motor skill?

Research has indicated that the personality of the learner and the stage of learning or learner's level of proficiency were all variables when predicting performance under emotional-stress situations. Emotional situations did not affect everyone in the same way; thus, the research has not been conclusive in explaining the relationship of emotions to skill acquisition. Nevertheless, important trends were indicated by the research.

The general implication from research was individuals with high or low anxiety levels will be affected differently under stressful situations. Carron (19) conducted research on the effect of an electric shock stressor upon the performance of high anxiety and low anxiety subjects practicing a difficult motor task. He hypothesized stress in the early stages of learning would have a detrimental effect upon performance of the high anxiety subjects and would not affect low anxiety subjects or might improve their performance. He also hypothesized stress during later stages of learning would help performance for both groups. Both hypotheses were supported by the data.

Brown and Shaw (17) investigated the effects of two personality traits, and their study supported the hypothesis. Ryan (69) in a study dealing with difficulty of a motor skill, supported the hypothesis that increased externally induced tension impaired performance on difficult motor tasks, but failed to support the hypothesis that tension improved performance on easy motor skills. Ryan concluded the subject's personality was a determining factor in how stress, anxiety, or tension was handled in performing motor skills. Conversely, Martens (58) in a study of the effects of anxiety, competition, and failure on performance of a complex motor task, found no significant difference between high and low anxiety subjects when placed in stressful conditions while completing a complex motor task.

The final area to be considered was the level of proficiency of the individual. Lazarus and Deese (55) found evidence which led them to suggest that emotional stress induced to a beginner, before skills have been well organized, produced a detrimental effect on learning. Stress induced to an individual of high skills produced a slight facilitating effect. James (47) studied the efficiency of relaxation and tension in performing an act of skill. His study showed performance while learning the skill was hindered by tension. The study by Castaneda and Lipsitt (20) demonstrated during early stages of learning that stress can be predicted to be harmful and in later stages of learning stress can be predicted to be helpful. Research tends to indicate emotional stress hinders beginning motor skill learning and facilitates motor skill learning at the higher proficiency skill levels.

The results of research are not conclusive at this time. Emotional factors such as stress, anxiety, or tension may assist, disrupt, or have no effect on motor skill learning. However, emotions are intermingled in motor skill learning. Their effects are dependent upon the personality of the individual and the stages of learning.

BIOFEEDBACK AND RELAXATION TRAINING

Feedback was first used by the developers of radio (49). Weiner defined feedback as a "method of controlling a system by reinserting into it the results of its past performance (49:3)." In research literature the terms feedback and knowledge of results have been widely used. Feedback has been associated with self-regulated stimulation or internal information (73). Feedback control on behavior or performance is therefore an internalized process. Mayr stated, "Every animal is a self-regulating system owing its existence, its stability, and most of its behavior to feedback controls (60:111)."

Many types of feedback exist such as audio, visual, proprioceptive, and kinesthetic. However, a new phenomenon in feedback is called biofeedback. "Biofeedback consists of giving a person immediate feedback on an internal physiological process through an external source, an instrument (42:327)." Biofeedback is biological feedback. It measures one's own biological processes and biofeedback training (BFT) "means using this information to change and control voluntarily the specific process or response being monitored (34:29)."

Biofeedback training involves the use of the electromyograph, an instrument which measures muscular contraction and relaxation with surface electrodes. Electrical discharges of motor neurons cause activation of muscle fibers and when a significant number of these discharges occur the muscle contracts. This electrical activity within the muscle is called electromyogram or EMG. EMG activity is expressed in uv or microvolts. "Since the microvolts of EMG is directly proportional to the mechanical muscle contraction, the EMG measures muscle relaxation and tonus (64:40)." Consequently, EMG can be used as a physiological index of muscular contraction and relaxation.

Biofeedback procedures are based on the principle of instrument autonomic conditioning. Birk (8) described instrument autonomic conditioning for biofeedback learning in the following manner:

> All biofeedback procedures follow the operant or instrumental paradigm of learning:
>
> Criterion (autonomic) response→reinforcing stimulus . . . with or without instruction, cognitive awareness or conscious intention to change a particular bodily function, the fundamental and irreducible paradigm of biofeedback is the operant conditioning of bodily responses that are usually largely out of awareness. (8:365-66)

This learning paradigm verified the underlying philosophy of biofeedback which is self-control (32). Control really exists with the individual and not with an outside source. The mind must allow the body to be conditioned through passive concentration; therefore, the mind is the key (37, 77). Brown stated, "It has become clear that man may, after all, have a mind resource to control his own being, down to the most minute fragments of his physical structure (13:24)."

However, researchers still have not shown any concrete evidence on how volition turns into action or on the unity of mind and body. "Through biofeedback techniques it has been discovered that the mind, in some as yet unknown way, can isolate and manipulate the muscle control system

. . . (14:123)." Green, Green, and Walters at the Menninger Foundation have hypothesized about the chain of events involved in the mind controlling autonomic process:

> Perception of somatic behavior (through biofeedback) → cortical (cognitive) elaboration → limbic (emotional) response → hypothalmic response → autonomic response → somatic response → perception of the somatic behavior. How volition enters into this scheme for self-regulation is not easy to say, but in any event each person becomes his own programmer, so to speak, when, through biofeedback, self-regulation of a physiological process is established. (34:159-60)

History of Relaxation Training

A pioneer who worked in the area of relaxation training was a Chicago physician, Jacobson. He began his work in 1908 at Harvard University. While there he investigated muscle relaxation as a treatment for anxious patients. In 1938, his studies and procedures for muscle relaxation were compiled in his book, Progressive Relaxation (45). Using this relaxation technique the patient focused on large muscle groups throughout the body. Patients were told to tense each muscle group for a few seconds after which they were told to release muscles and relax. After months of training the patient began to isolate muscle tension more finely (14). Using this procedure Jacobson successfully treated a variety of tension related disorders (46).

Continuing the research of Jacobson, Wolpe investigated fear reactions and the replacement of those reactions with another response. Jacobson's work with relaxation seemed ideal as a replacement for fear reactions and progressive relaxation exercises worked smoothly into the research. Consequently, Wolpe modified the procedure of Jacobson to include verbal instructions and hypnotic suggestion. From his work came two important developments: first, the total exercise program was more time efficient and second, his treatment of patients dealt with the circumstances surrounding anxiety (7).

Another form of relaxation training viewed as the forerunner of biofeedback was developed in Germany in the 1900's. The procedure was called autogenic training because control of muscles was self-generated and self-regulated (16). Vogt, a brain physiologist, had observed anxious patients in a hypnotic state and during this state he noticed a recuperative effect upon patients. "Vogt discovered patients were able to induce this hypnotic state within themselves by autosuggestion (14:129)." A few years later Schultz, a physician and co-worker with Vogt, became interested in the hypnotic state of patients and developed six exercises. These six exercises required patients to focus on verbal instructions which implied heaviness and warmth in the extremities (16). Schultz was successful but this phase of training required four to ten months (14).

The second phase of autogenic training involved meditation exercises which concentrated on visual imagery. It required the patient to imagine simple elements, objects, and finally one's own feelings. The exercises were successful only when patients used passive concentrations. Thus, Schultz is responsible for the concept of volition or passive concentration used in biofeedback training (14).

History of Biofeedback

Biofeedback research began in 1901 when Bair (15) performed the first experiment. He developed a device to report ear twitching and his subjects learned to control the muscles which wiggle the ear. However, not much value was placed on ear twitching so the experiment remained a novelty. In 1938, Mowrer and Mowrer (62) reported a biofeedback experiment using a tone signal to control bed wetting in children. Not until 1958 was the first monitored instrumental biofeedback training recorded. Lisina (14) used biofeedback to train her subjects to control constriction and dilation of blood vessels.

It was not until the 1960's that biofeedback began to really develop. Kamiya (34) started a bombardment of interest with his research of alpha brain wave rhythms and their self-regulation by college students. This wave of interest continued until researchers experimenting in biofeedback began to communicate with each other. To assist in the distribution of biofeedback research Brown, Mulholland, and Kamiya (53) formulated the Biofeedback Research Society.

A series of experiments beginning in 1967 and finishing in 1969 established biofeedback training as an effective technique of achieving muscle relaxation. Jacobs and Felton (44) demonstrated that visual EMG feedback significantly facilitated muscle relaxation in normal patients and patients with neck injuries. In 1969 Green, Walter, Green, and Murphy (36) showed that through EMG biofeedback training subjects achieved deep muscle relaxation and seven out of twenty-one of the subjects achieved neuromuscular silence within twenty minutes. It was the investigation of Budzynski and Stoyva (18) in deep muscle relaxation that finally established EMG biofeedback training as an effective technique of achieving muscle relaxation. In addition to these findings, EMG biofeedback training in muscle relaxation has been supported by the studies of Leaf and Gaarder (56), Whatmore and Kohli (80), Reinking and Kohli (67), Coursey (23), Raskin, Johnson, and Rondestvedt (66), Green, Green, and Walters (35), and research done at the Menninger Foundation by Green (74).

Biofeedback and Physical Education

The science of electromyograph biofeedback training is a relatively new area of study in the field of physical education. Researchers began in the 1960's to investigate the control and training of individual motor units within muscle groups. Harrison and Mortensen (40) were the first to demonstrate that subjects could isolate and control single motor units. Basmajian (5) confirmed the findings and also showed that individuals could perform special tricks with further training. Many other researchers followed to document and support the theory that adults and children can learn to isolate, train, and control motor units within muscle groups by using EMG biofeedback training (4, 33, 72).

Pursuing these original studies, researchers began using the electromyograph to explore whole muscle activity. EMG investigations were done to isolate such muscles as the sartorius (4, 48, 78), the pectineus (79), the teres major (12), and many others (11, 26, 31). Then in the 1970's physical educators began to use the electromyograph for muscle activity studies. Studies done in the physical education area examined muscle activity during exercise (10, 39), quadricep activity during knee extension and realignment (43, 61), ballistic movements (25), and muscle changes during the acquisition of motor skills (57). Others used the electromyograph to study muscle activities when performing a tennis forehand and backhand (1, 38), an overarm throw and a tennis serve (2), a volleyball overhead serve (70), a discus throw (29), and selected gymnastic stunts (52, 65).

As discussed, EMG studies in physical education have dealt with a wide variety of areas but few of these studies examined the benefits of EMG muscle relaxation training. In recent years, only two studies have examined EMG muscle relaxation training in physical education. Balog (3) investigated the effect of vigorous exercise on EMG biofeedback trainability. From the results it was concluded EMG biofeedback was effective in reducing muscle tension, EMG biofeedback was more effective than physical exercise in inducing muscle relaxation, physical exercise did not enhance learning of biofeedback, and a twenty minute session of biofeedback training was sufficient time for learning to occur. The other study by Knowlton, Cohen, and Thirer (51) was done to determine if EMG biofeedback training could change the physiological efficiency of subjects during sub-maximal exercise. The investigation demonstrated EMG biofeedback training can increase the physiological efficiency of a subject to do submaximal exercises.

Both of these studies demonstrated the newness of EMG biofeedback muscle relaxation training in the field of physical education. Many questions still exist; thus, more scientific work is needed in all aspects of EMG muscle relaxation training in physical education.

SUMMARY

The review of literature discussed three categories of learning theories: association, cognitive, and cybernetic. The association theories were based on a bond which existed between stimuli and response. The basis of the cognitive theories was perception or how the learner perceived the environment and gained insights. The cybernetic theory was established on a closed-loop system of sensory feedback and how feedback assisted in future performance.

Recently, models for skill acquisition have been developed. Even though the theorists did not agree on how motor skills are learned they did provide insights for theoretical, practical, and applied approaches to motor skill acquisition.

Many factors affect the learning of motor skills; however, only the relationship of emotions to motor skill learning was reviewed. Research in this area tended to indicate: (1) subject's personality was a determining factor in how stress or tension was handled while performing motor skills, and (2) emotional stress hindered the learning of motor skills by subjects at a low level of skill proficiency and facilitated motor skill learning by subjects at a high level of skill proficiency.

The final major section of this chapter discussed biofeedback which is a process of monitoring a physiological process with an instrument and immediately feeding back the internal information to the individual. Biofeedback techniques are based on the principle of instrumental autonomic conditioning and the philosophy of self-regulation. Even though it is yet unknown how volition turns into action, it has been proven that for biofeedback techniques to work the mind must allow the body to be conditioned through volition.

The study of muscle relaxation techniques started in the 1900's. Two forms of relaxation training were developed. Jacobson and Wolpe were responsible for the first form called progressive relaxation training in which individuals focused on muscle groups, tensed those muscles, then relaxed them. The second form of relaxation training was the forerunner to biofeedback and was developed by Vogt and Schultz. Autogenic relaxation training involved six exercises which produced feelings of heaviness and warmth in the extremities.

Even though biofeedback also started in the 1900's Kamiya was credited for beginning the surge of interest in the 1960's. Budzynski, Stoyva, and many others established biofeedback muscle relaxation training as an efficacious technique for deep muscle relaxation in 1969. Biofeedback training has been introduced to the field of physical education. Currently, only two studies have been done using EMG biofeedback muscle relaxation training in physical education.

Biofeedback muscle relaxation training in the field of physical education still has many unanswered or unexamined possibilities. The links between muscle relaxation and motor skill learning is still unknown. Should the hypothesis of this study be confirmed, the results would be of importance to physical educators and especially swimming instructors. Current literature is unable to provide necessary facts to support or to refute such a hypothesis. Thus, it is important to search for the relationship between EMG biofeedback muscle relaxation training and motor skill learning.

Chapter 3

METHODS AND PROCEDURES

The methods and procedures used to compare the difference in learning of beginning aquatic skills by two groups of non-swimmers, one participating in EMG muscle relaxation training and the other without muscle relaxation training have been presented in this chapter. The population as well as the sampling procedures have been described. The testing instrument plus biofeedback instrumentation and materials have been presented. In addition, the steps involved in data collection and the method selected for statistical analysis of the data have been included in this paper.

POPULATION AND SAMPLING

A total of forty students, all undergraduates, enrolled in elementary swimming classes during the fall semester of 1979 at Emporia State University were used as subjects for this study. These subjects were selected on the basis of enrollment in class plus the classification of non-swimmer. All subjects failed to pass the American Red Cross beginning and elementary backstroke skills pre test; thus, all subjects were classified non-swimmers. Age, sex, marital status, subject's academic major, and other similar factors, with the exception of undergraduate and non-swimmer classification, were not considered in this study.

The population sampling was considered random selection because each college student had the opportunity to enroll in the swimming classes. The random assignment of subjects to control and experimental groups involved several steps. Step one was the assignment of subjects to swimming test groups plus assignment of test numbers. On the first day of class each subject filled out an index card with name, address, telephone, and major. All cards from the 11:30 class were placed in a box. For assignment to groups each card was drawn out, given a number and a swimming test group, and returned to the box for the next drawing. Test group one included subjects with numbers one through twenty and swimming test group two was subjects with numbers twenty-one through forty. Drawing procedures for swimming test group assignment included drawing a card for group one and placing number one on the card and returning it to the box, then drawing a card for group two and placing number twenty-one on the card and returning it to the box. This procedure continued until all subjects had been assigned a swimming test group and a test number. The same procedure was followed for the 1:30 class except swimming test group one contained subjects with numbers forty-one through sixty and swimming test group two had subjects with numbers sixty-one through eighty.

Step two was the assignment of subjects to the control and experimental groups by stratified random sampling. After the pre test was finished each subject had a total score. From the total scores the researcher used the stratified random sampling procedure to sub-divide the population into three skill level groups--high, medium, and low skilled. Using a table of random numbers (9) the researcher arbitrarily selected row ten, columns fifteen and sixteen to be the starting place. Starting with the subjects' test numbers in the high skill level group, the first random number which matched a subject's test number was assigned to the experimental group. The second random number which matched a subject's test number was assigned to the control group. If a random number did not match a subject's test number the next number down was used. The next number down procedure was continued until a match was located. The medium and low skilled groups were done in the same manner until all subjects were in an experimental or a control group.

By using the stratified random sampling procedure the population was subdivided into homogeneous groups, thus allowing neither the control or experimental group to be assigned all the highly skilled or lowly skilled subjects. It also allowed for a more accurate representation by causing a mixture of experimental and control subjects in both classes.

MATERIAL AND INSTRUMENTATION

The American Red Cross beginning and elementary backstroke skill tests were used in order to obtain data necessary for this study. The items of this instrument were designed by the American Red Cross to assess students' progress and swimming capabilities. The elementary backstroke skill test is included in the test battery of Advanced Beginners by the American Red Cross; however, it was included in this study as a final determiner of beginning swimming skills. In other words, it was utilized as a final measurement check of the capabilities of beginning swimmers.

The American Red Cross skill tests are established on a pass/fail system. With this system it is impossible to separate the skill level of students except into high and low. So for this study separate ratings (Appendix A, page 64) of each American Red Cross test item were constructed to determine degrees of skill level. With this rating structure it was possible to assess skills to a greater extent, plus allowed for statistical analysis. In addition, the rating maximum score equaled the maximum standard established by the American Red Cross to pass each test item.

Biofeedback Instrument and Material

The biofeedback training sessions required many accessories. The training sessions were done in a quiet but dimly lighted environment, the personal growth lab in room 207 of Plumb Hall. Comfortable chairs with pillows for the neck and the ankles were provided. The Autogen 1500 electromyograph with three surface electrodes and earphones was used as the biofeedback training instrument. The surface electrodes consisted of two active electrodes and one ground electrode. The material required for the attachment of the electrodes to the frontalis muscles included cotton, alcohol, electrode attachment discs, and electrode contact gel. To assist in recording subjects' progress and reactions an EMG biofeedback log was utilized (Appendix B, page 70). Also used to assist the subject in developing an awareness of sensations which caused the body to relax was the inclusion of imagery tapes (Appendix C, page 72).

Biofeedback training was established as an effective technique of achieving deep muscle relaxation by Budzynski and Stoyva (18). They also established the validity of EMG muscle relaxation training using the frontalis muscles as placement sights for electrodes (16). Voas (37) showed in his research that the frontalis muscles had a reliability coefficient of .95 for total muscle relaxation. Smith (71) demonstrated that eight weeks was sufficient training time. In general, thirty minutes are considered ample time for one training session in muscle relaxation (64). Consequently, this technique of achieving muscle relaxation merited being used for this study.

DESIGN OF THE STUDY

This study was designed to investigate the difference in learning of beginning swimming skills by two groups of non-swimmers. At the outset of this research, it was determined and assumed that the American Red Cross beginning and elementary backstroke skill tests would measure the subjects' performance in beginning swimming skills. On this basis, it was determined that the subjects' performance scores would serve as a means of determining the difference in learning between the two groups.

Two variables were presented and dealt with in this study. The independent variable was EMG muscle relaxation training and the dependent variable was performance scores. The intervening variable was learning. The undergraduate and non-swimmer status of all subjects in this study was used as control variables.

An experimental design was used for this study. It required rigorous management of variables and conditions which were handled through randomization. It focused on control and experimental groups and used the control group as a baseline against which to make comparisons. Most important the purpose of the design was to create a situation in which the effect of a single variable (EMG muscle relaxation training) could be studied.

DATA COLLECTION

The subjects for this study were selected from those students who enrolled in elementary swimming classes. The American Red Cross beginning and elementary backstroke skill tests were selected to measure subjects' performance in beginning swimming skills. In order to collect data from the skill tests the following steps were taken.

First, the color coded scoring tape was placed on the pool deck. Using the assistance of one of the scorers, the researcher and the scorer laid a tape measure beside the pool edge. Following the color code (Appendix D, page 77) the researcher laid color tape at specific intervals along side of the tape measure. This procedure was done on both sides of the pool.

Second, test personnel were contacted by the researcher to establish individual meeting dates. During the judges' and scorers' meeting the responsibility sheets were discussed and questions were answered (Appendix E, page 79). Specific reading of color coded tape on pool deck was explained in detail to both scorers. Demonstrators' meetings were held at the conclusion of the first class meeting in which the researcher got into the water to explain and demonstrate how each test item was to be done (Appendix E, page 79). All demonstrators and judges were water safety instructors. Both judges in charge of swimming test groups had previously taught a college elementary swimming class.

Third, students were told that the pre test was to give the instructors an idea of skill level and where to begin instruction. They were asked not to practice swimming during the testing period. They were told that if a skill was beyond their capabilities simply to pass. Students were also informed that others would be in to administer test items so the instructor would be free to watch both swimming test groups. This was all done on the first class meeting. The pre test took the next two class periods to complete. All subjects were given the same directions and demonstrations prior to performing any of the thirteen test items. The test rating forms (Appendix F, page 86) were collected and compiled for comparison with post test data (Appendix G, page 93).

The fourth step was taken during the fourth class period. During this time students were informed of the real reason for the pre test. The researcher explained the research and the use of EMG biofeedback training. During the class period the biofeedback contracts (Appendix H, page 95) and swimming notebook extra credit assignments (Appendix I, page 97) were passed out to the appropriate students. The director of the personal growth lab and person in charge of the EMG biofeedback muscle relaxation training explained the biofeedback training procedure, the biofeedback log, and brought a sign up sheet for the first week of training. Students were again asked not to participate in swimming practice outside of class and those not involved in the biofeedback training were asked to wait until the study was completed before trying any of the instruments over at the lab. Subjects participating in muscle relaxation training were informed to use techniques learned in the lab while involved in swimming instruction and class practice. All experimental subjects agreed to and signed the contract before returning it to the researcher upon the completion of the class period.

The next step to the collection of data was eight weeks of swimming instruction and biofeedback training. During this time the researcher utilized the aid of two certified WSI college students as instructors for each class. Each class was divided into three teaching groups according to pre test scores. The researcher taught one group and each student instructor taught a group. The student instructors were aware of the research and the exactness required in their instruction. Each instructor received detailed lesson plans (Appendix J, page 100). On every Thursday the lesson plans for the following week were given to each instructor. A short meeting was held at the conclusion of class on Thursdays to discuss progress, special needs of students, or to answer questions about lesson plans. Thus from these discussions the researcher was kept aware of progress of special learning situations that needed to be included in lesson plans. To help control any bias student instructors were not told which subjects were in the control or experimental group.

Another control of bias was accomplished by having the director of the personal growth lab and her assistant do all the biofeedback training with the experimental group. The experimental group took biofeedback training three times a week with each session being thirty minutes. One session per week included the use of imaginery tapes to assist subjects in developing an awareness to sensations which caused the body to relax. The biofeedback training included a quiet atmosphere and comfortable chairs. The hook-up to the electromyograph included this step-by-step electrode attachment procedure for each subject before every training session. First, the forehead was cleaned with cotton saturated with alcohol. Second, the double adhesive electrode discs were removed from their backing and placed on the electrodes, making certain the disc was centered over the cup of the electrodes. Third, the electrode cup was filled with electrode contact gel, making certain gel did not run over the top of the cup. Fourth, the second electrode adhesive backing was removed and the two active electrodes were attached to the subject's frontalis muscles. Finally, the ground electrode was attached to the subject's forehead between the two active electrodes and the cables were draped over the subject's ears and the Autogen 1500 was turned on. Subjects used both visual and audio displays for feedback. They were to concentrate and cultivate those sensations which caused the meter and tones to deflect downward. Subjects' training started at x1.0 meter scale reading. As feedback learning progressed subjects were encouraged to lower the meter reading scale during training sessions. Each subject was allowed to select the feedback mode for each training session. The threshold mode was set at reading one for the entire study.

To assist the researcher in checking attendance to biofeedback training a double check system was utilized. The first check was the biofeedback log and the second check was the sign up sheet sent to the researcher each week by the director of the lab. The researcher then compiled the total visits per week on the attendance record sheet (Appendix K, page 105). In this manner, the researcher could keep track of which subjects were completing their obligations toward the biofeedback contract.

The final step to the collection of data was the administration of the post test. One week before the post test all test personnel were reminded of the test dates. The same test personnel administered the post test. Students involved with muscle relaxation training were told to use those techniques during the testing. It took two class periods to complete and the same procedures were followed as used in the pre test. The test forms were collected and compiled for analysis. Thus the data for this study included pre and post test performance scores.

DATA ANALYSIS

An analysis of the data of the difference in learning between the two groups of non-swimmers was based on the pre and post test performance scores obtained on each item of the American Red Cross beginning and elementary backstroke skill tests. The *t*-tests for correlated means (Appendix L, page 107) were used to analyze the learning of swimming skills by the control and experimental groups. Also *t*-tests for uncorrelated means (Appendix L, page 107) were used to determine if a significant difference in learning existed between the two groups of non-swimmers. In addition, the *t*-tests were calculated on a Monroe computer to assure statistical accuracy. The .05 level of significance was utilized to test the null hypothesis for this study.

Chapter 4

ANALYSIS OF DATA

This study was designed to investigate the difference in learning of beginning swimming skills by two groups of non-swimmers, one participating in EMG biofeedback muscle relaxation training and the other without muscle relaxation training. The necessary information was obtained by administering a pre and post test of the American Red Cross beginning and elementary backstroke skill tests to thirty-four subjects involved in this study. The results of this study are discussed in this chapter.

SUBJECT AND PROCEDURE ANALYSIS

There was a total of forty subjects originally involved in this study. Three persons from the experimental group did not finish the required biofeedback training and were dropped from the study. A total of three, one from the experimental and two from the control group, dropped the swimming classes. Thirty-four subjects completed the pre and post swimming tests and the appropriate number of subjects from the group of thirty-four completed the required biofeedback training.

Originally the swimming test battery included a test for the back glide. This test was dropped from the battery after the pre test. The standard distance established by the Red Cross for completion of this skill was six feet. For the college student just pushing off from the side of the pool meant completion. Even the swimmers who did not try any other test items tried and scored maximum points on this particular test item. Consequently, it was dropped from the test battery because the maximum distance was not far enough to evaluate degrees of skill for college students.

BIOFEEDBACK RESPONSE ANALYSIS

Though no statistical analysis was done on the achievement of muscle relaxation through biofeedback, the material from item number twelve of the completed biofeedback check list (Appendix M, page 110) indicated muscle relaxation was achieved. Subjects being trained in muscle relaxation answered how generally relaxed they felt before training. At the conclusion of eight weeks of biofeedback training the subjects again answered how generally relaxed they felt. Nine out of thirteen reported their general relaxation was facilitated by EMG muscle relaxation training. One subject did not complete the before and after biofeedback check list and three subjects did not complete the after biofeedback check list.

Item number twelve of the completed biofeedback check list was rated by each subject on a scale from one to ten. A rating of ten indicated a subject felt tense and a rating of one indicated that a subject felt relaxed. Thus, the lower the rating the more relaxed and the higher the rating the more tension the subject felt. The subjects' responses to item number twelve before and after biofeedback training are indicated below in Table 1.

Table 1

Biofeedback Responses of Experimental Group to Item Number Twelve on Degrees of General Relaxation

Subjects	Before Training	After Training
1	2.8	.8
2	6.5	3.0
3	2.0[b]	2.0
4	6.7	2.3
5	1.0[b]	1.0
6	6.0	4.0
7	3.7	4.3
8	.5[b]	1.0
9	9.0[a]	6.0
10	5.7	1.8
11	8.1[a]	6.0
12	10.0[a]	8.0
13	4.0	2.5
14	5.2	---[c]
15	5.2	---[c]
16	5.5	---[c]
17	---[c]	---[c]

[a]Larger numbers represented tension.

[b]Smaller numbers represented relaxation.

[c]--- did not complete biofeedback check list.

STATISTICAL ANALYSIS

The analysis of learning of beginning swimming skills and differences of learning by the two groups of non-swimmers has been made according to pre and post test performance scores on the American Red Cross beginning and elementary backstroke skill tests. The thirteen items on the American Red Cross skill tests were performed by the thirty-four subjects. The *t*-test for correlated means was the most appropriate statistical tool for analyzing the learning of beginning swimming skills and the *t*-test for uncorrelated means was the statistical tool used to analyze the differences in learning between the two groups of non-swimmers, one participating in EMG biofeedback muscle relaxation training and the other without muscle relaxation training.

t-Test for Correlated Means

A *t*-test for correlated means was done to analyze learning of swimming skills by the control and experimental groups. Table 2 summarizes the data on beginning swimming skill learning.

Table 2

Summary Table--Learning of Beginning Swimming Skills by Control and Experimental Groups

Group Classification	M_1	r	s_1	df	*t* value
Control	17.6058	16.4732	3.9953	16	4.4066*
Experimental	17.2000	15.1552	3.6756	16	4.6793*

*Significant at .05 and .01 level (Appendix L, page 107)

A $\underline{t}$ value of $\underline{t} \geq 2.12$ at .05 level or $\underline{t} \geq 2.58$ at .01 level was needed to demonstrate significance. It was concluded that the obtained value of $\underline{t}$ was greater than the tabled values; thus, both groups learned beginning swimming skills.

t-Test for Uncorrelated Means

The $\underline{t}$-test for uncorrelated means was used to determine if a significant difference in learning existed between two groups of non-swimmers, one participating in EMG biofeedback muscle relaxation training and the other with no muscle relaxation training. A summary of the $\underline{t}$-test analysis for pre and post test has been tabulated in tables 4-19. (Appendix N, page 113) No significant difference in learning was found to exist between the two groups of non-swimmers. The $\underline{t}$-test table of pre and post test totals is shown below in Table 3.

Table 3

Summary Table--Control and Experimental Groups
Pre and Post Swimming Test Totals

Test Classification	m_1^a	m_2^b	s_1^c	s_2^d	df	$\underline{t}$ value
Pre Test	52.1705	51.1117	20.0412	21.0301	16	.1502[e]
Post Test	69.7764	68.3117	8.4864	7.9602	16	.5190[e]

[a]Mean for Control Group.

[b]Mean for Experimental Group.

[c]Standard Deviation for Control Group.

[d]Standard Deviation for Experimental Group.

[e]Not significant at the .05 level (Appendix L, page 107)

A $\underline{t}$ value of $\underline{t} \geq 2.04$ was needed to reject the null hypothesis at the .05 level of significance. Therefore, since the obtained value of $\underline{t}$ was less than the tabled value, retainment of the null hypothesis was warranted. However, several test items did warrant further analysis.

The tabled value of $\underline{t}$ at the .1 level of significance was $\underline{t} \geq 1.70$. Test item number five, floating on back, had a $\underline{t}$ value of 1.8889 which was significant at the .1 level. Also very close to being significant at the .1 level was test number nine, back arm stroke, and test number eleven, combined stroke on back. Both tests, number nine and eleven, had a $\underline{t}$ value of 1.4605. This statistical information is not conclusive but it does indicate muscle relaxation may indeed have some effect on learning beginning swimming skills on the back.

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter contains a summary of the investigation to determine if a difference in learning existed between two groups of non-swimmers, one participating in EMG biofeedback muscle relaxation training and the other with no muscle relaxation training. The second section was the conclusions drawn from the statistical analysis. The final section of this chapter presented recommendations for further studies.

SUMMARY

The purpose of this study was to investigate the difference in learning between two groups of non-swimmers, one participating in EMG biofeedback muscle relaxation training and the other without muscle relaxation training. It was hypothesized that there would be no significant difference in learning between the two groups of non-swimmers. Implications for better understanding of the benefits of EMG muscle relaxation training and how it could be related to teaching techniques in the field of physical education added to the importance of this study.

Thirty-four subjects who were classified as non-swimmers and enrolled in elementary swimming classes were used to test the hypothesis of this study. Each of the subjects completed the American Red Cross beginning and elementary skills pre and post tests. Also subjects involved with the experimental group completed eight weeks of EMG biofeedback muscle relaxation training. The performance scores from the swimming pre and post tests were used to test the hypothesis of the study.

A *t*-test for correlated means was performed on the performance scores obtained by each subject on the American Red Cross beginning and elementary backstroke skill tests. A significant difference was found to exist at the .05 and .01 level of significance. This statistical analysis indicated that both the control and experimental groups did learn beginning swimming skills.

The hypothesis of the study was tested by performing *t*-tests for uncorrelated data. The performance scores for each subject on the American Red Cross beginning and elementary skills pre and post tests were used for *t*-tests. No significant difference was found to exist between the learning of the two groups of non-swimmers at the .05 level. Therefore, the null hypothesis of the study was retained.

It was found that a significant difference existed at the .1 level for test number five, back floating. Two other tests, back arm stroke and combined back stroke were not significantly different at this level but were close enough to suggest that muscle relaxation could possibly assist learning of beginning aquatic skills on the back.

CONCLUSIONS

The following conclusions seem justified:

1. The two groups did not differ significantly in their learning of beginning aquatic skills, but both groups did learn beginning aquatic skills as indicated by the *t*-tests.

2. Subjects trained in EMG biofeedback muscle relaxation did display a slight difference in learning on the tests requiring skills on the back.

3. Number of subjects was too low to obtain significant differences in learning.

4. As indicated by experimental subjects' responses, the EMG biofeedback training did facilitate their ability to relax.

RECOMMENDATIONS

The following recommendations for other studies are made in regard to the findings of the present study:

1. A replication of the study should be done using other age levels for the sample.

2. A replication of the study should be done using college volunteers who have a fear of the water.

3. A replication of the study should be done using another type of test instrument or a test instrument which is specifically constructed for evaluating college age students' swimming abilities.

4. A replication of the study should be done having subjects train in EMG muscle relaxation before taking swimming lessons.

5. A replication of the study should be done with a larger sample size.

6. A replication of the study should be done with a longer period of time for biofeedback training.

7. A replication of the study should be done using subjects who possess a lesser degree of skill. One of the problems with the present study might have been that subjects skill level was too high at the beginning of the study.

8. A similar study using a total relaxation concept approach in instructing students in a swimming class should be made. In other words, instructor focuses on relaxation by the students while developing aquatic skills.

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APPENDICES

APPENDIX A

Description of the American Red Cross Beginning and Elementary Backstroke Skill Tests and Ratings

American Red Cross Beginning and Elementary Backstroke Skill Tests (63)

Test 1 Breath holding.

Rating:
0 ________ No try
1 ________ Held breath for 1-2 seconds
2 ________ Held breath for 3-4 seconds
3 ________ Held breath for 5-6 seconds
4 ________ Held breath for 7-8 seconds
5 ________ Held breath for 9-10 seconds

Description: Standing in waist deep water, bend from waist and hold breath with face fully submerged for 10 seconds.

Test 2 Bobbing.

Rating:
0 ________ No try
1 ________ Bob 1-2 times
2 ________ Bob 3-4 times
3 ________ Bob 5-6 times
4 ________ Bob 7-8 times
5 ________ Bob 9-10 times

Description: Standing in waist deep water, bob alternately inhaling through mouth above surface of water and exhaling through mouth and nose with head completely submerged; do this rhythmically and continuously 10 times.

Test 3 Prone float.

Rating:
0 ________ No try. Improper body position
1 ________ Prone float 1-2 seconds
2 ________ Prone float 3-4 seconds
3 ________ Prone float 5-6 seconds
4 ________ Prone float 7-8 seconds
5 ________ Prone float 9-10 seconds

Description: Standing in waist deep water, take a prone position (on stomach) for 10 seconds and recover to standing position unaided.

Test 4 Prone glide.

Rating:
0 ________ No try or improper prone position
1 ________ Prone glide 1-2 feet
2 ________ Prone glide 3-4 feet
3 ________ Prone glide 5-6 feet

4 _______ Prone glide 7-8 feet
5 _______ Prone glide 9-10 feet

Description: In waist deep water, push off the side with one foot with face down in water and arms extended over head, glide in this position for 10 feet and recover to standing position unaided.

Test 5 Back float.

Rating: 0 _______ No try
1 _______ Back float for 1-2 seconds
2 _______ Back float for 3-4 seconds
3 _______ Back float for 5-6 seconds
4 _______ Back float for 7-8 seconds
5 _______ Back float for 9-10 seconds

Description: In waist deep water, assume a back floating position, hold this position with face above water for 10 seconds, resume standing position unaided.

Test 6 Prone glide with flutter kick.

Rating: 0 _______ No try; arm movement; improper flutter; improper prone glide position
1 _______ Prone glide/flutter 1-4 feet
2 _______ Prone glide/flutter 5-8 feet
3 _______ Prone glide/flutter 9-12 feet
4 _______ Prone glide/flutter 13-16 feet
5 _______ Prone glide/flutter 17-20 feet

Description: In waist deep water, push off the side with one foot in a prone position with face down in water and hands extended over head, immediately begin flutter kick after push off, proceed for 20 feet and resume standing position unaided.

Test 7 Back glide with flutter kick.

Rating: 0 _______ No try; arm movement; improper flutter kick
1 _______ Back glide/flutter 1-4 feet
2 _______ Back glide/flutter 5-8 feet
3 _______ Back glide/flutter 9-12 feet
4 _______ Back glide/flutter 13-16 feet
5 _______ Back glide/flutter 17-20 feet

Description: In waist deep water, hold onto side with both feet on the side under water, lean back, push off, and glide on back with arms at side, immediately after push off begin flutter kick and proceed for 20 feet, resume standing position unaided.

Test 8 Arm stroke.

Rating:
0 _______ No try; improper crawl arm action
1 _______ Crawl arm stroke 1-4 feet
2 _______ Crawl arm stroke 5-8 feet
3 _______ Crawl arm stroke 9-12 feet
4 _______ Crawl arm stroke 13-16 feet
5 _______ Crawl arm stroke 17-20 feet

Description: In waist deep water, hold onto side, push off with one foot on the side in a prone position, immediately after push off perform crawl arm action with legs flutter kicking or trailing motionless for 20 feet.

Test 9 Back arm stroke.

Rating:
0 _______ No try; improper finning or sculling; leg movement
1 _______ Back arm stroke 1-4 feet
2 _______ Back arm stroke 5-8 feet
3 _______ Back arm stroke 9-12 feet
4 _______ Back arm stroke 13-16 feet
5 _______ Back arm stroke 17-20 feet

Description: In waist deep water, hold onto side, lean back, push off using both feet, immediately begin finning or sculling for 20 feet. No leg movements may be used.

Test 10 Crawl stroke.

Rating for distance:
0 _______ No try; head out of water
1 _______ Crawl stroke for 1-4 yards
2 _______ Crawl stroke for 5-8 yards
3 _______ Crawl stroke for 9-12 yards
4 _______ Crawl stroke for 13-16 yards
5 _______ Crawl stroke for 17-20 yards

Rating for form:
0 _______ No try
1 _______ Poor form
2 _______ Marginal form
3 _______ Average form
4 _______ Good form
5 _______ Superior form

Look for this in form:
Body position--linear; correct alignment; correct action
Arm action--correct pattern of movement; proper angle or position of limb part; not sloppy; synchronized
Leg action--correct pattern of movement;

not sloppy; timing
Coordination--fluidness of motion; synchronization of body parts; timing of phases

Description: In waist deep water, swim the crawl stroke for 20 yards. Arm and leg action must be coordinated with ability to breathe when necessary and continue stroking.

Test 11 Combined stroke on the back.

Rating:

0 ______ No try; improper finning or sculling; no flutter kick
1 ______ Combined back stroke 1-2 yards
2 ______ Combined back stroke 3-4 yards
3 ______ Combined back stroke 5-6 yards
4 ______ Combined back stroke 7-8 yards
5 ______ Combined back stroke 9-10 yards

Description: In waist deep water, hold onto side, lean back, push off with two feet on the back, immediately begin finning or sculling movement of arms and flutter kick of legs for 10 yards.

Test 12 Plain front dive and crawl stroke.

Rating for distance:

0 ______ No try
1 ______ Crawl stroke for 1-4 feet
2 ______ Crawl stroke for 5-8 feet
3 ______ Crawl stroke for 9-12 feet
4 ______ Crawl stroke for 13-16 feet
5 ______ Crawl stroke for 17-20 feet

Rating for form:

0 ______ No try
1 ______ Belly flop
2 ______ Poor form--Any propulsion of the body toward the water is gained solely by the use of the legs; no body extension on entry; entry is shallow in a near horizontal position; distance 4-10 feet from side of pool
3 ______ Average form--Some use of arms in gaining height on the spring; limited control of body position; following take off hips flex before the legs are pressed upward; prior to entry legs are thrown upward in an attempt to bring the legs into alignment;

legs carried beyong the trunk and head position; entry 6-10 feet from side of pool

4 _______ Good form--Coordination of arms and legs during the take off; body extended from take off to completion of entry; near vertical entry within 6 feet of side of pool

5 _______ Excellent form--Maximum height attained during take off; inversion of body takes place smoothly; complete extension of body is assumed during take off and is held until dive is completed; entry is made in vertical position within 4 feet of side of pool

Description: Do a deep water dive into deep water, upon reaching surface with head above water begin swimming crawl stroke for 20 feet.

Test 13 Elementary backstroke.

Rating for distance:

0 _______ No try
1 _______ Elementary backstroke for 1-4 yards
2 _______ Elementary backstroke for 5-8 yards
3 _______ Elementary backstroke for 9-12 yards
4 _______ Elementary backstroke for 13-16 yards
5 _______ Elementary backstroke for 17-20 yards

Rating for form:

0 _______ No try
1 _______ Poor form
2 _______ Marginal form
3 _______ Average form
4 _______ Good form
5 _______ Superior form

Look for this in form:
Body position--linear correct alignment
Arm action--correct pattern; proper angle; synchronized
Leg action--correct pattern; correct timing; not sloppy
Coordination--fluidness of motion; synchronization of body parts; timing of phases

Description: Swim using the elementary backstroke for 20 yards.

APPENDIX B

Sample of a Completed EMG
Biofeedback Log

EMG BIOFEEDBACK PRACTICE LOG

Name ______________________________

Directions: (1) Lab assistant attach electrodes. (2) Choose meter scale and feedback mode most conducive to your training. (3) See lowest reading you can get in approximately ten minutes. (4) Turn thoughts inward to total body relaxation and practice an additional twenty minutes.

Date	Feed back Mode	Beginning Reading	Lowest EMG in ten minutes	What were you AWARE of while practicing (what thoughts/ feelings/ sensations)? What was different/unique about today's practice?
9/10	CL	3	1.5	Feedback helps you realize what kinds of things relax you and what ones cause more·tension. I had never been exposed to a biofeedback machine nor seen or heard about the things which can be done on the machine. It is an interesting experience.
9/11	Listened to tape			Felt very relaxed. No tension anywhere once I got situated. The slow talking on the tape really relaxes me.
9/13	CL	2½	1.5	I couldn't get the reading down unless I closed my eyes and really concentrated. The tension from not being ready for a big test showed up mainly in the temples. I'm aware that the tension is there but the only way to lessen it is by closing my eyes and letting myself go.
9/18	CL	1.5	1.0	Relaxed. I tried to relax today while giving a presentation. I tried to breathe slowly and let the tension flow. I said you're relaxed don't be nervous. I think it helps.
9/20	Listened to tape			The tape relaxes you because of the slow talking. The bath tub was a good example because when you think of taking a nice warm bath you are automatically more relaxed.
9/22	CL	1.25	1.0	I've noticed that I can now focus on individual parts better. Like the jaw, eyes, and temples. There were things I noticed whereas I could relax better. IF I concentrate on sleeping, I could relax my muscles better.

APPENDIX C

Written Sample of an Imagery Tape

BATHTUB TAPE

M. F. Headrick

Make your body as comfortable as you can. If you can't lie down then sit so shoulders are supported. Now first take a deep breath and let it out. What we are doing is trying to stretch the muscles of your chest cavity just enough to give you the feel of tension and relaxation. Now take as much air in again as you can, another deep breath, let all of it out, let all the air you can get out and see if you can get in touch with the feeling of heaviness. Heaviness and warmth that will spread in your body, in your chest cavity, your rib cage, and down in your joints. Breathe out as you would in a deep sleep and as you breathe out see if you can spread that heaviness and warmth throughout your body. That feeling will be what will help you get the deepest relaxation. Try to get this feeling of heaviness and warmth.

The first thing I will do is to lead you through focusing on muscles of your body. So start on the forehead, see if there is any tension there, find any tension just let it go, let it go as you would relax your hand from a fist. Find any tension in your forehead just let it go, check your temples and your ears and see if there is any tension there and if any just let it go. Check around your eyes, cheeks, and jaws and let that feeling of heaviness follow. Check in your mouth and tongue and down in your throat. Now let's check out in your hands and arms, see if you can relax your fingers and hands. Check in your forearm and see if there is any tension there and then check up into your upper arms. If you find any tension just release it. Then check up in your shoulders, neck, and then check very slowly down your spine. Start at the back of your neck, just check and release, check and release just like a massage. All the way down your spine just checking and releasing. Now let's check in your rib cage and chest area release any tension you find there. Then check in your abdomen release any tension you find there. Then try to release any tension you might have deep in your gut region all through the lower trunk, just keep checking and releasing. Then check down in your hips check in your buttock and thigh, just let any tension you find go, just let it go. Then check low legs and feet, just let it run out into a puddle. Tension all draining out.

Now let's have you envision that you are lying in a big big warm bathtub. Wide enough so you have all the freedom you want. Just lie there relaxed. However deep you want, you are just lying in a very warm bathtub. I want the feeling of heaviness, weightless heaviness you get in a bathtub. Feeling just the body relaxing. Then repeat to yourself, twice or three times each statement I will make. Repeat as slowly as you want these statements. I feel quiet. I am beginning to feel quite relaxed. I am beginning to feel quite relaxed. My forehead, my jaws and my neck feel very relaxed. They feel comfortable and smooth. They feel comfortable and smooth. My forehead and scalp feel comfortable and smooth. My chest and my abdomen feel quiet and relaxed. My chest and my abdomen feel quiet and relaxed. The whole central portion of my body feels relaxed. My hips, knees, ankles feel heavy relaxed and comfortable. My hips, knees, ankles feel heavy relaxed and comfortable. My feet feel heavy and relaxed. My feet feel heavy and relaxed. I am quite relaxed. My hands and arms are heavy and warm. My hands and arms are heavy and warm. My hands feel very warm. My hands feel very warm. I feel very quiet. I feel very quiet. My whole body is relaxed and my hands are warm. My whole body is relaxed and my hands are warm. My body and hands are relaxed and warm. My body and hands are relaxed and warm. Warmth is flowing into my hands. Warmth is flowing into my hands. I can feel them warming. I can feel them warming. I can feel the warm flowing down my arms into my hands. I can feel the warm flowing down my arms into my hands. My hands are warm, relaxed and warm. My hands are warm, relaxed and warm. My whole body feels quite comfortable and relaxed. My whole body feels quite comfortable and relaxed. I withdraw my thoughts from the surroundings. I withdraw my thoughts from the surroundings. I feel serene and still. I feel serene and still. My thoughts are turned inward and I am at ease. My thoughts are turned inward and I am at ease. I feel life and energy flowing through my legs and hips. I feel that energy flowing through my abdomen and chest. I feel this life and energy flowing through my arms and hands, neck and head. The energy makes me feel peaceful and alive. I feel peaceful and alive. Within my mind I can visualize myself. I can visualize myself as relaxed, comfortable and still. I experience myself as relaxed, comfortable and still. I am alert but in an easy quiet inward turned way. My mind is calm and quiet. My mind is calm and quiet. I feel inward serenity. I feel inward serenity.

Now I would like for you to envision at the end of your bathtub is a light colored wall. To that wall release all the clutter that is still remaining. All that is not quiet and serene. Release on the wall. Leave your mind calm quiet and serene. Then when all the quietness is there and all clutter is gone draw a black curtain across that blocks it all out all but softness and calm and serenity.

Now I will count one, two, three and when I get to three take a deep breath. Take a deep deep breath and wiggle your fingers or toes and as slowly as you like you may open your eyes and reactivate your body.

APPENDIX D

Description of the Color Code

COLOR CODE

Each color has five markings to match rating numbers for judges.

GREEN for Test 4

First tape mark---2 feet
Second tape mark--4 feet
Third tape mark---6 feet
Fourth tape mark--8 feet
Fifth tape mark--10 feet

RED for Tests 6, 7, 8, 9, 12

First tape mark---4 feet
Second tape. mark--8 feet
Third tape mark--12 feet
Fourth tape mark-16 feet
Fifth tape mark--20 feet

YELLOW for Test 11

First tape mark---6 feet
Second tape mark-12 feet
Third tape mark--18 feet
Fourth tape mark-24 feet
Fifth tape mark--30 feet

BLUE for Tests 10, 13

First tape mark--12 feet
Second tape mark-24 feet
Third tape mark--36 feet
Fourth tape mark-48 feet
Fifth tape mark--60 feet

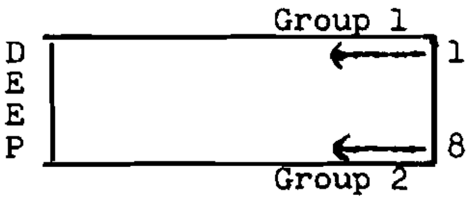
APPENDIX E

Description of Responsibilities for Judges, Scorers, and Demonstrators

JUDGES' RESPONSIBILITIES

I. Duties
   1. To score all students on rating forms
   2. To place students in numerical order before testing
   3. To read description of each test item
   4. To answer all questions during testing
   5. Final decision if test item is being performed by student as described by test description

II. Facility Layout
   1. Test group 1 will be swimming in lane 1
   2. Test group 2 will be swimming in lane 8
   3. All test items except #12 will be done from shallow end toward deep end
   4. Test #12 will be done from deep end toward shallow end



III. Procedure
   1. Each student will have a test number for testing. Use this number on the rating forms.
   2. Group 1--11:30 class test numbers are from 1-20
      Group 2--11:30 class test numbers are from 21-40
      Group 1-- 1:30 class test numbers are from 41-60
      Group 2-- 1:30 class test numbers are from 61-80
   3. Testing groups will be brought to testing area by the demonstrator for that test group. Judge will be responsible for having students line up in numerical order before testing begins.
   4. Move students so they can see demonstration. Judge read description of test from rating forms. Demonstrator will then demonstrate test item. Judge then ask students if they have any questions. Begin testing students in numerical order. Test all students before moving on to the next test item.
   5. For timing test items (1, 3, 5) scorer will give command to swimmer ready, go, stop, next. Scorer will report to judge seconds received by swimmer and judge will mark the rating form accordingly.
   6. For counting test item (2) judge will give command to swimmer ready, go, stop, next. Scorer will

also count to assist judge. Judge mark rating form according to bobs done correctly by swimmer.

7. On measurement tests (4, 6, 7, 8, 9, 10, 11, 12, 13) scorer will give rating according to distance reached by swimmer. Judge mark rating forms. Scorer is responsible for telling demonstrator to stop swimmer when maximum distance has been achieved.
8. Judge remember to record test number on rating forms.
9. Test items (10, 12, 13) will be rated on form and distance by two other judges and the judge in charge.

IV. Form Judges
1. Rate test items (10, 12, 13) on form and distance.
2. Standards are on rating forms which are included with this sheet.
3. Be sure to mark student's test number on each rating form.

V. General Comments
1. Bring a clip board.
2. Judge in charge if assistance is needed a flag is located on the starting blocks for each test group. Just raise it for assistance.
3. Box is located in each test group area for collection of recorded rating forms.
4. Pencils, tape measures, stop watches will be provided by the instructor.
5. Judges, students have been informed that if a skill is beyond their capabilities to pass. You mark 0 on the rating form and go on.
6. Judges have the authority to stop students if skill is being performed wrongly and mark rating form. No second chances.

SCORERS' RESPONSIBILITIES

I. Duties
   1. Report times, count, or distance to judge.
   2. Be ready for each swimmer.
   3. Keep things moving.
   4. Know what test item you are scoring.
   5. Know what tape color you are using.
   6. Arrive ten minutes before classes. Class times are 11:30 and 1:30 Tuesday and Thursday.
   7. Bring a clip board and this sheet for reference.
   8. Tape measure, digital watches, and pencils will be provided by instructor.

II. Scoring Procedure
   1. Timing--use conorus digital watch, round to the nearest second. Have second conorus watch around neck in case of failure of first watch.
   2. For test items 1 and 3 stand next to judge, give command to swimmer ready, go, stop and give judge the time.
   3. Measurement
      a. All measurements are taken from the swimmer's shoulders.
      b. Colored taped marks are on pool deck. They correspond to rating numbers. Example: first tape mark equals rating one and fifth tape mark equals rating five.
      c. On command ready go from judge, walk along the edge of pool as swimmer swims. Report to judge the last tape mark reached. Example: swimmer swims in between marking four and three, scorer would report three to judge.
      d. Tell demonstrator when time, count, or distance (maximum) has been achieved so she may stop swimmer.
   4. Any questions or problems during testing, wave red flag for my attention.
   5. Tape measures will be available in case of failure of colored tape sticking to pool deck.

III. Testing--Color Code and Maximum Time or Distance
   1. Breath holding--10 seconds
   2. Rhythmic Breathing--10 times
   3. Prone float--10 seconds
   4. GREEN--Prone float--10 feet
   5. Back float--10 seconds
   6. RED--Prone glide with flutter kick--20 feet
   7. RED--Back glide with flutter kick--20 feet
   8. RED--Arm stroke--20 feet

9. RED--Arm stroke on back--20 feet
10. BLUE--Crawl stroke--60 feet
11. YELLOW--Combined stroke on back--30 feet
12. RED--Front dive and crawl stroke--20 feet
13. BLUE--Elementary backstroke--60 feet

DEMONSTRATORS' RESPONSIBILITIES

I. Duties
   1. Demonstrate each test item after the description is read by the judge.
   2. Be ready for next test item. Keep things moving.
   3. Assist judge or scorer in stopping swimmer.
   4. Arrive ten minutes before class. Class times are 11:30 and 1:30 on Tuesday and Thursday.
   5. Bring this sheet to testing for reference.
   6. Lead swimming test group to specific testing area.

II. Descriptions of Tests
   1. Breath holding. Standing in waist deep water, bend from waist and hold breath with face fully submerged for 10 seconds.
   2. Rhythmic breathing (bobbing). Standing in waist deep water, bob alternately inhaling through mouth and nose with head completely submerged; do this rhythmically and continuously 10 times.
   3. Prone float. Standing in waist deep water, take a prone position (on stomach) for 10 seconds and recover to standing position unaided.
   4. Prone glide. In waist deep water, push off the side with face down in water and arms extended over head, glide in this prone position for 10 feet and recover to standing position unaided.
   5. Back float. In waist deep water, assume a back floating position, hold this position with face above water for 10 seconds, resume standing position unaided.
   6. Prone glide with flutter kick. In waist deep water, push off the side in a prone position with face down in water and hands extended over head, immediately begin flutter kick, proceed for 20 feet and resume standing position unaided.
   7. Back glide with flutter kick. In waist deep water, hold onto side, lean back, push off, and glide on back with arms at side, immediately after push off begin flutter kick and proceed for 20 feet, resume standing position unaided.
   8. Arm stroke. In waist deep water, hold onto side, push off in prone position, immediately after push off perform crawl arm action with legs trailing or using flutter kick for 20 feet.
   9. Arm stroke on back. In waist deep water, hold onto side, lean back, push off on back and immediately begin finning or sculling for 20 feet. No leg movements may be used.

10. <u>Crawl stroke</u>. In waist deep water, swim the crawl stroke for 20 yards. Arm and leg action must be coordinated with ability to breathe when necessary and continue stroking.
11. <u>Combined stroke on back</u>. In waist deep water, hold onto side, lean back, push off on the back, immediately begin finning or sculling movements of arms and flutter kick of legs for 10 yards.
12. <u>Plain front dive and crawl stroke</u>. Dive into deep water, upon reaching surface with head above water begin swimming crawl stroke for 20 feet.
13. <u>Elementary backstroke</u>. Swim using the elementary backstroke for 20 yards.

APPENDIX F

Description of Test Rating Forms

Pre Test 1*

Post Test 1

Student Number ______

Rating: 0	______	No try
1	______	Held breath for 1-2 seconds
2	______	Held breath for 3-4 seconds
3	______	Held breath for 5-6 seconds
4	______	Held breath for 7-8 seconds
5	______	Held breath for 9-10 seconds

Test Description: Breath holding. Standing in waist deep water, bend from waist and hold breath with face fully submerged for 10 seconds.

Pre Test 2

Post Test 2

Student Number ______

Rating: 0	______	No try
1	______	Bob 1-2 times
2	______	Bob 3-4 times
3	______	Bob 5-6 times
4	______	Bob 7-8 times
5	______	Bob 9-10 times

Test Description: Rhythmic breathing (bobbing). Standing in waist deep water, bob alternately inhaling through mouth above surface of water and exhaling through mouth and nose with head completely submerged; do this rhythmically and continuously 10 times.

Pre Test 3

Post Test 3

Student Number ______

Rating: 0	______	No try. Improper body position
1	______	Prone float 1-2 seconds
2	______	Prone float 3-4 seconds
3	______	Prone float 5-6 seconds
4	______	Prone float 7-8 seconds
5	______	Prcne float 9-10 seconds

Test Description: Prone float. Standing in waist deep water, take a prone position (on stomach) for 10 seconds and recover to standing position unaided.

*Note: Pre and Post Test was circled according to test being administered.

Pre Test 4

Post Test 4

Student Number _______

Rating: 0 _______ No try or improper prone position
1 _______ Prone glide 1-2 feet
2 _______ Prone glide 3-4 feet
3 _______ Prone glide 5-6 feet
4 _______ Prone glide 7-8 feet
5 _______ Prone glide 9-10 feet

Test Description: Prone glide. In waist deep water, push off the side with one foot with face down in water and arms extended over head, glide in this position for 10 feet and recover to standing position unaided.

Pre Test 5

Post·Test 5

Student Number _______

Rating: 0 _______ No try
1 _______ Back float for 1-2 seconds
2 _______ Back float for 3-4 seconds
3 _______ Back float for 5-6 seconds
4 _______ Back float for 7-8 seconds
5 _______ Back float for 9-10 seconds

Test Description: Back float. In waist deep water, assume a back floating position, hold this position with face above water for 10 seconds, resume standing position unaided.

Pre Test 6

Post Test 6

Student Number _______

Rating: 0 _______ No try; arm movement; improper flutter; improper prone glide position
1 _______ Prone glide/flutter 1-4 feet
2 _______ Prone glide/flutter 5-8 feet
3 _______ Prone glide/flutter 9-12 feet
4 _______ Prone glide/flutter 13-16 feet
5 _______ Prone glide/flutter 17-20 feet

Test Description: Prone glide with flutter kick. In waist deep water, push off the side with one foot in a prone position with face down in water and hands extended over head, immediately begin flutter kick after push off, proceed for 20 feet and resume standing position unaided.

Pre Test 7

Post Test 7

Student Number _______

Rating: 0 _______ No try; arm movement; improper flutter kick
1 _______ Back glide/flutter 1-4 feet
2 _______ Back glide/flutter 5-8 feet
3 _______ Back glide/flutter 9-12 feet
4 _______ Back glide/flutter 13-16 feet
5 _______ Back glide/flutter 17-20 feet

Test Description: Back glide with flutter kick. In waist deep water, hold onto side both feet on side under water, lean back, push off, and glide on back with arms at side, immediately after push off begin flutter kick and proceed for 20 feet, resume standing position unaided.

Pre Test 8

Post Test 8

Student Number _______

Rating: 0 _______ No try; improper crawl arm action
1 _______ Crawl arm stroke 1-4 feet
2 _______ Crawl arm stroke 5-8 feet
3 _______ Crawl arm stroke 9-12 feet
4 _______ Crawl arm stroke 13-16 feet
5 _______ Crawl arm stroke 17-20 feet

Test Description: Arm stroke. In waist deep water, hold onto side, push off of the side with one foot under the water in a prone position, immediately after push off perform crawl arm action with legs flutter kicking or trailing motionless for 20 feet.

Pre Test 9

Post Test 9

Student Number _______

Rating: 0 _______ No try; improper finning or sculling; leg movements
1 _______ Back arm stroke 1-4 feet
2 _______ Back arm stroke 5-8 feet
3 _______ Back arm stroke 9-12 feet
4 _______ Back arm stroke 13-16 feet
5 _______ Back arm stroke 17-20 feet

Test Description: Back arm stroke. In waist deep water, hold onto side, lean back, push off using both feet, immediately begin finning or sculling for 20 feet. No leg movement may be used.

Pre Test 10

Post Test 10

Student Number ______

Rating for distance:	0 ______	No try; head out of water	
	1 ______	Crawl stroke 1-4 yards	
	2 ______	Crawl stroke 5-8 yards	
	3 ______	Crawl stroke 9-12 yards	
	4 ______	Crawl stroke 13-16 yards	
	5 ______	Crawl stroke 17-20 yards	
Rating for form:	0 ______	No try	Look for this in form:
	1 ______	Poor form	Body position--linear correct alignment
	2 ______	Marginal form	Arm Action--correct pattern; proper angle; synchronized
	3 ______	Average form	Leg Action--correct pattern; correct timing; not sloppy
	4 ______	Good form	Coordination--fluidness of motion; synchronization of body parts; timing of phases
	5 ______	Superior form	

Test Description: American front crawl. In waist deep water, swim the crawl stroke for 20 yards. Arm and leg action must be coordinated with ability to breathe when necessary and continue stroking.

Pre Test 11

Post Test 11

Student Number ______

Rating:	0 ______	No try; improper finning or sculling; no flutter
	1 ______	Combined back stroke 1-2 yards
	2 ______	Combined back stroke 3-4 yards
	3 ______	Combined back stroke 5-6 yards
	4 ______	Combined back stroke 7-8 yards
	5 ______	Combined back stroke 9-10 yards

Test Description: Combined stroke on back. In waist deep water, hold onto side, lean back, push off with two feet on the back, immediately begin finning or sculling movement of arms and flutter kick of legs for 10 yards.

Pre Test 12

Post Test 12

Student Number ______

Rating for form:	0	______	No try
	1	______	Belly flop
	2	______	Poor form--any propulsion of the body toward the water is gained solely by the use of the legs; no body extension on entry; entry is shallow in a near horizontal position; distance 4-10 feet from side of pool
	3	______	Average form--some use of arms in gaining height on the spring; limited control of body position; following take off hips often flex before the legs are pressed upward; prior to entry legs are thrown upward in an attempt to bring the legs into alignment; legs carried beyond the trunk and head position; entry 6-10 feet from side of pool
	4	______	Good form--coordination of arms and legs during the take off; body extended from take off to completion of entry; near vertical entry within 6 feet of side of pool
	5	______	Excellent form--maximum height attained during take off; inversion of body takes place smoothly; complete extension of body is assumed during take off and is held until dive is completed; entry is made in vertical position within 4 feet of side of pool
Rating for distance:	0	______	No try
	1	______	Crawl stroke 1-4 feet
	2	______	Crawl stroke 5-8 feet
	3	______	Crawl stroke 9-12 feet
	4	______	Crawl stroke 13-16 feet
	5	______	Crawl stroke 17-20 feet

Test Description: Plain front dive and crawl stroke. Do a deep water dive into deep water, upon reaching surface with head above water begin swimming crawl stroke for 20 feet.

Pre Test 13

Post Test 13

Student Number ______

Rating for form:

0	_______	No try
1	_______	Poor form
2	_______	Marginal form
3	_______	Average form
4	_______	Good form
5	_______	Superior form

Look for this in form for elementary backstroke:
Body position--linear; correct alignment
Arm action--correct pattern; proper angle; synchronized
Leg action--correct pattern; correct timing; not sloppy
Coordination--fluidness of motion; synchronization of body parts; timing of phases

Rating for distance:

0	_______	No try
1	_______	Elementary backstroke for 1-4 yards
2	_______	Elementary backstroke for 5-8 yards
3	_______	Elementary backstroke for 9-12 yards
4	_______	Elementary backstroke for 13-16 yards
5	_______	Elementary backstroke for 17-20 yards

Test Description: Elementary backstroke. Swim using the elementary backstroke for 20 yards.

APPENDIX G

Description of Tally Sheets

Tally Sheet for Pre Test Scores and Post Test Scores

Directions: Score in Red the pre test. Score in Blue the post test. First score for Test Items 10, 12, and 13 is form and then distance.

Student Name	Student Number	Test 1	2	3	4	5	6	7	8	9	10		11	12		13		Total Score

APPENDIX H

Description of the EMG Biofeedback Training Contract

Biofeedback Relaxation Lab
Personal Growth Center, Plumb Hall 207
Emporia State University

TRAINING AGREEMENT

I agree to enter the Biofeedback Relaxation Training program. I understand that this will require me to reserve the time necessary and make the effort necessary for such training in the following manner:

> I will spend at least 3 half-hour practice sessions per week on the EMG biofeedback instrument for a duration of 8 weeks.

I understand that I am: (1) to meet the designated times to learn the technique, (2) to apply the technique when swimming, and (3) permitted to ask questions about my training at any time.

I am aware that this service is offered for my own personal awareness and development and does not prepare or certify me to train others.

I also understand that if I complete my training with two or less absences I will receive 40 extra credit points toward my swimming class grade.

____
Signature

____
Date

APPENDIX I

Description of the Swimming Notebook

SWIMMING NOTEBOOK

Due Date: November 15, 1979

Extra Credit: I understand that with the completed research of the topics below I will receive 40 extra credit points toward my swimming class grade.

Directions: Written in ink, one side of the paper or typed. Make this an <u>extensive</u> study. Bibliography included at the end.

I. History of swimming
   A. Nature, purpose and value of swimming
   B. Facilities and equipment
      1. pool
      2. lake
      3. ocean
      4. waterfront
   C. Safety procedures
II. Beginners
   A. Adjusting to the water
   B. Breath control
   C. All types of floating
   D. Types of leg kicks used in swimming
   E. Types of arm strokes
   F. Crawl stroke
   G. Elementary backstroke (make certain you describe the whip)
   H. Jumping into water
III. Advanced work
   A. Side stroke
   B. Over-arm side stroke
   C. Back crawl
   D. Breaststroke (make certain you describe the whip kick)
   E. Inverted breaststroke
   F. Trudgen stroke
   G. Trudgen crawl
   H. Butterfly
IV. Other necessary skills
   A. Treading water
   B. Bobbing
   C. Drown-proofing
   D. Diving
      1. beginning--how does teaching progress?
      2. from a board
      3. 5 stunt dives

E. Competitive swimming
  1. conditioning
  2. racing turns and starts
  3. differences in strokes--competitive vs. regular
  4. judging a swimming meet
  5. running a swimming meet--things to do before, during, and after
F. Underwater swimming
G. Surface dives

V. Synchronized swimming
  A. Variations from regular swimming
  B. Description of 5 basic stunts

VI. Lifesaving skills
  A. Approaches
  B. Defense and releases

VII. Novelty events--describe how to play each game
  A. 5 games for beginners
  B. 5 relays for beginners
  C. 5 games for advanced swimmers
  D. 5 relays for advanced swimmers

APPENDIX J

Sample Lesson Plans

LESSON PLAN

Class Elementary Swimming
Supervisor ______
Date 9-11-79
Equipment Rings, Boards

Approximate Time	Activities	Organization and Procedure
2 minutes	Bobbing	1. Have students bob 10 times by themselves 2. Bob 20 times holding hands with partner--alternate students up and down 3. Stress correct breathing and exhaling through mouth and nose
3 minutes	Opening eyes	1. Explain why we want them to open eyes underwater 2. Demonstrate how painless it is to open eyes 3. Working in partners a. Count fingers--have one partner go under water, open eyes, tell other partner how many fingers were being held up underwater. Switch b. Rings--have one partner hold ring underwater and other partner tries to pick it up. Start with successful reaches and continue until ring is on bottom of pool and student can pick it up.
10 minutes	Flutter kick on stomach	1. Stress extended legs, point toes. Move feet alternately up and down 12-15 inches. Bring heels to surface and limit the amount of splash. Emphasize the down beat kick from hips. 2. Start with bracket, you may have to move feet through range of motion 3. Flutter kick using the board

10 minutes	Prone float	1. Working in partners a. Have partner face partner grasping hands b. Have partner take breath, place face into the water c. Have other partner walk backward lifting partner's feet off bottom d. Have partner help floating partner regain feet e. After student is at ease in step c, have partner release grip. Student assumes standing position without help. f. Have partner observe, but not touch, student floating in prone position.
10 minutes	Back float	1. Demonstrate the back float Emphasize: Shoulders in water, place back of head in water, lean backward and push gently with feet to place body in horizontal back position. Ears in water, face up. To regain feet: lift face out of water as knees are bent swing feet under knees and toward hips; press arms downward and backward 2. Working in partners a. Have partner stand behind student. Partner supports back of student's head as it is placed in water. Student looks at ceiling. b. Have student gently push off bottom, arms at side. Partner retains support. Partner helps student regain feet. c. After floating position is reached have partner withdraw support but remain available for help. d. Have student move arms and put feet under buttocks. Partner helps by lifting student's upper back. e. Have partner observe, but not touch, student floating and regaining feet. f. Switch

LESSON PLAN

Class Elementary Swimming
Supervisor ________
Date 9-11-79
Equipment Boards

Approximate Time	Activities	Organization and Procedure
2 minutes	Elementary Backstroke	1. Demonstrate elementary backstroke 2. While students are dry have them practice the whip kick with legs over edge of pool 3. Stress knee together and toes out
1 minute	Bobbing	1. Have students bob 15 times
20 minutes	Elementary Backstroke	1. With partner a. Hold onto gutter, practice whip kick; instructor walk on deck and assist; other partner may give support in small of back if needed. Switch b. One partner support neck and small of back while student swims across width of pool using the whip kick. Switch c. Standing in water, students go through arm action with instructor on deck and also coordinate the legs and arms d. With partner at neck walk backward while student swims elementary backstroke the width of pool. Switch
10 minutes	Flutter kick	1. Instructor demonstrate using bracket. Students practice flutter kick using bracket. 2. Number off by twos. Each student has a board. Ones swim using kick board with arms extended face in water; then twos. Same procedure except this time on the back without kick boards. Use this combination until all students have gone 4 times.

10 minutes	Sculling	1. Instructor demonstrate. Same numbers. Have ones scull to the instructor, then twos, then back to edge. 2. Add sculling and flutter kick the width of pool by numbered groups.

APPENDIX K

Description of the Biofeedback
Attendance Record Sheet

Week of: ____________________

BIOFEEDBACK ATTENDANCE RECORD SHEET

Name	Monday	Tuesday	Wednesday	Thursday	Friday	Total

Note: Subjects' names were typed on the original stencil and eight copies were made to keep attendance record on each biofeedback training session attended by each subject in the experimental group.

APPENDIX L

Statistical Tools Used in This Study

STATISTICAL TOOLS

The following *t*-test formulas for uncorrelated and correlated data, given by Blommers and Forsyth (9), were used in this study.

t-test for Uncorrelated Data

$$t = \frac{M_1 - M_2}{\tilde{\sigma}_{M_1 - M_2}}$$

where, M_1 = mean of first group

M_2 = mean of second group

$\tilde{\sigma}$ = estimated standard error of sampling distribution

t-test for Correlated Data

$$t = \frac{M_1 - M_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} - 2r \frac{s_1}{\sqrt{n_1}} \frac{s_2}{\sqrt{n_2}}}}$$

where, M_1 = mean of first group

M_2 = mean of second group

n_1 = number in group one

n_2 = number in group two

s_1^2 = variance for group one

s_2^2 = variance of group two

s_1 = standard deviation of group one

s_2 = standard deviation of group two

r = correlation

LEVEL OF SIGNIFICANCE (9)

When using the t-test for uncorrelated data, the t value given below was needed in this study to warrant rejection of the null hypothesis:

1. A tabled value of $t \geq 2.04$ was needed to reject the null hypothesis at the .05 level of significance.

Also using the t-test for uncorrelated data the t value given below was needed to warrant significant difference on specific swimming test items:

1. A tabled value of $t \geq 1.70$ was needed to warrant a significant difference at the .1 level.

When using the t-test for correlated data, the t value given below was needed in this study to warrant significance:

1. A tabled value of $t \geq 2.12$ was needed to warrant significance at the .05 level.
2. A tabled value of $t \geq 2.58$ was needed to warrant significance at the .01 level.

APPENDIX M

Description of the Biofeedback Check List

Name: ______________
Training Group: ______________
Date: ______________
Pre-Training ________
Post-Training ________

EMPORIA STATE BIOFEEDBACK CHECK LIST

M. F. Headrick

Instructions: Make a mark (__/__) across each line somewhere between the two extremes. IMPORTANT: Describe your general rather than your isolated reactions.

Concentration:

1.	Can't keep my mind on lectures, studying, etc.	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Can easily focus and keep my attention
2.	Can't keep my mind on what others are saying	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Can easily focus on conversations
3.	Never worry	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Worry continuously

Sleep:

4.	Sleep soundly	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Sleep interrupted frequently
5.	Never lie awake	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Lie awake each night
6.	Lie awake for at least an hour each night	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Lie awake for less than 2 minutes each night
7.	Awaken tired and sluggish	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Awaken refreshed

Temperament:

8.	Lose temper easily	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Seldom lose temper
9.	Feel daily irritation	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Seldom feel irritation
10.	No friction with people I live with	|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|-+-|	Constant friction between me and people I live with

11.	Constant friction between me and people I work with	No friction with people I work with

Body Awareness:

12.	Generally feel relaxed	Generally feel tense
13.	Fidget a lot	Can sit, stand, or lie calmly and easily
14.	Never have cold hands	Hands always cold
15.	Headache nearly every day	Never have a head-ache

APPENDIX N

t-tables for Individual Swimming Tests

Table 4

t-table for Pre and Post Holding Breath Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	4.6470	.8642	32	.4458
Experimental (Pre)	17	4.7647	.6642		
Control (Post)	17	.0000	.0000	32	.0000
Experimental (Post)	17	.0000	.0000		

Table 5

t-table for Pre and Post Bobbing Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	2.7647	1.9212	32	1.7201
Experimental (Pre)	17	3.8823	1.8668		
Control (Post)	17	4.8235	.7276	32	.2461
Experimental (Post)	17	4.7647	.6642		

Table 6

t-table for Pre and Post Prone Floating Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	4.2941	1.6868	32	.2045
Experimental (Pre)	17	4.1764	1.6671		
Control (Post)	17	.0000	.0000	32	.0000
Experimental (Post)	17	.0000	.0000		

Table 7

t-table for Pre and Post Prone Gliding Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	4.1176	1.9647	32	.0875
Experimental (Pre)	17	4.0588	1.9516		
Control (Post)	17	4.9411	.2425	32	.9999
Experimental (Post)	17	5.0000	.0000		

Table 8

t-table for Pre and Post Back Floating Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	3.7647	1.8550	32	.8333
Experimental (Pre)	17	3.1764	2.2426		
Control (Post)	17	4.7647	.9701	32	1.8889*
Experimental (Post)	17	3.8235	1.8109		

*Significant at .1 level (See Appendix L, page 107)

Table 9

t-table for Pre and Post Prone Glide with Flutter Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	4.3529	1.5387	32	.4928
Experimental (Pre)	17	4.5882	1.2277		
Control (Post)	17	4.9411	.2425	32	.8340
Experimental (Post)	17	4.8235	.5285		

Table 10

t-table for Pre and Post Back Glide with Flutter Kick Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	4.1764	1.7042	32	1.1165
Experimental (Pre)	17	3.4705	1.9722		
Control (Post)	17	4.5882	1.2776	32	1.1190
Experimental (Post)	17	4.9411	.2425		

Table 11

t-table for Pre and Post Arm Stroke Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	4.0588	1.9516	32	.4159
Experimental (Pre)	17	3.7647	2.1656		
Control (Post)	17	4.7058	1.2126	32	1.0000
Experimental (Post)	17	5.0000	.0000		

Table 12

t-table for Pre and Post Back Arm Stroke Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	4.000	1.9685	32	.9927
Experimental (Pre)	17	3.2941	2.1726		
Control (Post)	17	4.7647	.6642	32	1.4605
Experimental (Post)	17	5.0000	.0000		

Table 13

t-table for Pre and Post Crawl Stroke Form Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	1.3705	.9285	32	.3342
Experimental (Pre)	17	1.4823	1.0193		
Control (Post)	17	2.5000	.8739	32	.0376
Experimental (Post)	17	2.4882	.9446		

Table 14

t-table for Pre and Post Crawl Stroke Distance Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	3.1764	1.9759	32	.2609
Experimental (Pre)	17	3.3529	1.9666		
Control (Post)	17	4.4705	.9432	32	.5694
Experimental (Post)	17	4.6470	.8617		

Table 15

t-table for Pre and Post Combined Back Stroke Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	3.7058	2.1726	32	.5254
Experimental (Pre)	17	3.2941	2.3917		
Control (Post)	17	5.000	.0000	32	1.4605
Experimental (Post)	17	4.8823	.3321		

Table 16

t-table for Pre and Post Diving Form Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	1.4176	1.4706	32	.0000
Experimental (Pre)	17	1.4176	1.5046		
Control (Post)	17	2.4882	.9955	32	.7215
Experimental (Post)	17	2.1823	1.4366		

Table 17

t-table for Pre and Post Diving and Swimming Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	2.6470	2.5724	32	.0000
Experimental (Pre)	17	2.3529	2.5724		
Control (Post)	17	4.7085	1.2126	32	1.4552
Experimental (Post)	17	3.8235	2.1861		

Table 18

t-table for Pre and Post Elementary Backstroke Form Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	.9705	.7998	32	.0220
Experimental (Pre)	17	.9764	.7578		
Control (Post)	17	2.5529	.7624	32	.5123
Experimental (Post)	17	2.4058	.9051		

Table 19

t-table for Pre and Post Elementary Backstroke Distance Test for Control and Experimental Groups

Groups and Test	N	Mean	Standard Deviation	df	*t*
Control (Pre)	17	2.7058	2.0846	32	.4683
Experimental (Pre)	17	3.0588	2.3040		
Control (Post)	17	4.7058	.9851	32	.5523
Experimental (Post)	17	4.5294	.8744		