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A Comparison of Two Methods of Developing Arm Endurance in Swimming the American Crawl

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A COMPARISON OF TWO METHODS OF DEVELOPING ARM ENDURANCE IN SWIMMING THE AMERICAN CRAWL

by

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J. W. J.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

THE PROBLEM AND ITS SCOPE

Statement of the Problem

This study represents an attempt to determine the value of the "float-a-foot" device as an aid to swimmers in their development of the hand-over-hand arm stroke.

Purpose of the Study

The purpose of this study was to determine the effectiveness of the "float-a-foot" in the development of arm movements used in swimming strokes. It was hypothesized that the effectiveness would have a high, positive correlation with swimming proficiency and thus indicate that the "float-a-foot" floatation device could be a valuable aid for aquatics instructors to use.

Nature and Justification of the Problem

Our American society has the tendency to designate a person who is able to swim as: a person who is able to advance through the water with the American Crawl stroke. A more tangible criteria is the passing of the American National Red Cross Beginner Skills Test.[1] The two final skills of the above test involve swimming the American Crawl over a distance of thirty yards. The writer therefore, believes this stroke to be the fundamental swimming stroke.

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[1] Water Safety Instructor's Manual: Swimming and Lifesaving Courses, Washington, D.C.: The American National Red Cross, 1961, p. 56.

Yet, it is a complex stroke and difficult for beginning swimmers to learn and develop. To cope with the learning of such a complex stroke, swimming instructors usually choose the part-whole method in teaching the stroke.

The mechanics of each part of the stroke (e.g. breathing, arm stroke, and leg stroke) are taught and practiced separately on deck and in shallow water until they can be executed effectively. When these steps have been accomplished, the parts are combined. At this point students and teachers realize the need for going back to work on the parts in order to develop strength and endurance in each part.

In developing the leg phase of the stroke and, even during the process of learning, a device known as the kickboard is often used. It enables the learner to maintain the trunk of the body in a floating horizontal position. In addition, it enables the learner to concentrate on the leg position and movements with limited interference of breathing and upper body activity. For the development of endurance in breathing a technique known as "bobbing" in deep water is used. For the arm phase, however, no equivalent device or technique has been invented or discovered that can be used effectively, insofar as the writer has been able to determine.

Swimmers attempt to hold kickboards between their legs while executing the arm phase. This is inadequate for three reasons:

1. The legs are carried too high in the water. This places the body in an undesirable position.
2. The lower part of the body is tense, as it squeezes

the board between the legs to hold it securely in place. This often causes the entire body to become tense and prevents relaxation which is a factor in swimming effectively and efficiently.

3. The board is structurally difficult to hold and often slippery. The pressures exerted upon it by the legs and water cause it to fall away from the legs. This interrupts the swimmer's stroke. The board must be retrieved and placed once more into position. This wastes time and energy.

From the above the writer has concluded that a supplemental device or technique is needed for developing the arm phase. Subsequently the "float-a-foot" device was developed.

Delimitations of the Study

This study was limited to:

1. The hand-over-hand arm stroke.
2. A consideration of women students only.
3. Subjects who had reached the American National Red Cross intermediate ability level.
4. The use of experimental, homemade "float-a-foots."
5. The use of the "float-a-foot" for arm and shoulder girdle strength development necessary for distance swimming.

Definitions

Float-a-foot - A floatation device attached to the ankles of a swimmer which inhibits the legs from kicking in an alternate fashion and allows them to float a few inches under the surface of the water. The feet slip through the loops up to the ankles placing the plastic foam ball between the feet. A diagram of the device may be found in Appendix A.

Aid - (for aquatics instructors) Any object, procedure or device which could speed or make easier the learning and development process. Some aquatics aids presently widely accepted are:

a) kickboards

b) weighted blocks or bricks

c) ring buoys

d) films and filmstrips

e) progression charts

f) American National Red Cross Skill Sheets

Intermediate Swimmer - A person who has passed the American National Red Cross Beginner Skills Test or who is able to swim at least thirty yards using a combined stroke on the front side of the body.

Distance Swim - For the purpose of this paper the writer will give two definitions: A general definition is used in the body of the paper, and the specific definition as related to the experiment.

General: Swimming a designated distance and timed or not timed.

Specific: Swimming a distance of 150 yards and being timed to the nearest second.

Trail-leg Method - A method used in developing the arm stroke of the American Crawl in which the legs are held together by a rubber loop around the ankles. This prevents the use of the legs in a flutter-kick fashion. The legs merely trail along behind the body.

CHAPTER II

REVIEW OF RELATED LITERATURE

It seems, apparently, little research has been conducted concerning the use of apparatus aids in the learning and the development of swimming strokes. The writer located studies which sought to determine the effectiveness of flotation devices and music on the learning of swimming strokes and skills.

In a study by Bruce,[2] the use or non-use of conscious relaxation and a flotation device were employed as methods of learning beginning swimming strokes and skills. The criterion test given yielded two measures: A time score and a rating score. The analysis of time scores showed no significant interaction between the two factors. In addition, the time score did not show differences between the use and non-use of conscious relaxation nor the use or non-use of a flotation device. Analysis of the rating scores showed neither a significant interaction nor significant difference between the use and non-use of conscious relaxation. A significant difference, however, was found in favor of non-use of a flotation device.

Dillon,[3] in her study found music to be a valuable aid in the

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[2]Patricia J. Bruce, "The Effects of Conscious Relaxation and a Flotation Device on Learning Beginning Swimming" (unpublished P.E.D. dissertation, State University of Iowa, 1961), 208 p.

[3]Evelyn K. Dillon, "Music as a Teaching Aid," Research Quarterly, XVIII (March, 1947), 1-8.

teaching of swimming. Her conclusion states that intermediate swimmers being taught with music improve more in swimming form and swimming speed than do swimmers who are taught without music.

Various apparatus and devices have been developed for use in the water though not in relation to swimming as indicated by a report of Aquatic Apparatus of the 19th Century.[4] Pictures and explanations of the apparatus appear in Appendix B. Current catalogs and advertisement sections of magazines advertise devices for aiding swimmers.[5] One such advertisement suggests the use of a belt device 1/25 inches thick worn hidden under a bathing suit or trunks. It states the device will "float you at ease with little effort" and you will have "no more fear of deep water" because the "adjustable buoyance makes anyone unsinkable."

Though research on the use of water apparatus methods for training is limited, research appears in print concerning techniques of out-of-water training for swimming performance. Most of this research has been conducted since 1956. Smith[6] found that arm extensor strength training may increase swimming speed over a short distance. In his experiment a control group of nineteen students were given "normal workouts." A second group designated as the experimental group participated in the "normal workouts" and

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[4]"Aquatic Apparatus of the 19th Century," Friends, March, 1964, p. 9.

[5]Young Beautiful, April, 1964.

[6]Donald Charles Smith, "Correlation of Arm Extensor Strength Training With Speed Swimming" (unpublished M.S. dissertation, Dept. Physical Education, University of California, Los Angeles, California, 1959), 47 p.

exercise with fifteen arm extensions against maximal resistance from springs.

Much research has been conducted in the last five years on the effectiveness of weight training and dry land training of swimmers. Nunney[7] conducted a study using a circuit training program to determine the extent to which it would be of assistance to increase the endurance, speed, and strength of swimmers. The training consisted of six activities, four in which weights were used and two which did not use weights. Three of the four activities using weights were devoted to upper body work. The fourth was a leg exercise. The amount of weight for each activity was arbitrarily determined but was such as to be within the range of the subjects. The two non-weights activities were included to give vigorous, general exercise to promote efficiency of the circulatory and respiratory systems. The experimental group made significant gains in swimming endurance, speed, and selected strength factors. The control group made significant gains in swimming endurance but not in swimming speed nor selected strength factors.

Davis[8] attempted to determine the effect of a vigorous and comprehensive weight training program upon speed in swimming the crawl stroke. His findings revealed that after the weight training period all 17 subjects increased their speed in swimming the crawl

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[7]Derek N. Nunney, "Relation of Circuit Training to Swimming," Research Quarterly XXXI (May, 1960), p. 188-198.

[8]Jack F. Davis, "The Effects of a Weight Training Program on Speed In Swimming," Physical Educator XII (1955), p. 28-29.

stroke. He concluded that his information would seem to indicate that weight training is highly beneficial to swimming.

A study conducted by Thompson and Stull[9] on the effects of training and conditioning for distance swimming might indicate, with the following conclusions, the significance of specificity of training: (1) students who participated in weight training solely did not significantly improve group speed; (2) students who participated in a program of weight training and general swimming significantly improved their performance in swimming but not speed; and (3) students who participated in various training programs of speed swimming techniques and speed swimming itself significantly improved their performances in speed of swimming.

Another aspect of specificity of training is the application of isometric contractions to movements which are specific to movements of swimming strokes. Counsilman[10] reports after a three year isometric training program for the swimming teams at Indiana University that "isometric contractions have their limitations... however, they have been of value..."

Several writings concerned with methods of teaching strokes were found by the writer. Shead[11] found the part-progression method

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[9]H.L. Thompson and G.A. Stull, "Effects of Various Training Programs on Speed of Swimming," Research Quarterly, XXX (December, 1959), p. 478-488.

[10]James Counsilman, "A Dry Land Exercise Program For Swimmers," Paper read before the research section of the 1963 national AAHPER convention, Minneapolis, Minnesota, May, 1963.

[11]John Edward Shead, "The Relative Effectiveness of Teaching Two Basic Swimming Strokes by Two Methods to Nonswimmers," (unpublished P.E.D. dissertation, Indiana University, 1959), 325 p.

superior to the pure-part method in teaching the crawl and backstroke to nonswimmers. The two methods were used in teaching 103 children for 19 days. The criterion measure was distance and time in swimming toward an object 45 feet from the start. Levellen[12] in comparing the "part" method with the "whole" method in teaching the "human" stroke (dog paddle) to students from seven and one-half years to nine found the "whole" method superior.

Another methodology study by Mohr and Barrett[13] discovered that presenting knowledge of mechanical principles governing performance of intermediate skills aids in the learning of the skills. Garland[14] in her study of the effectiveness of problem solving in learning swimming presented these conclusions: Swimmers taught by the problem solving method showed significant gain over the control group who were taught by standard methods only in performance of the elementary backstroke. For the other strokes there were no significant differences. The experimental group was motivationally stimulated, developed self-direction and learned faster.

Summary of Review of Literature

The review of the related literature included in this investi-

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[12] John O. Levellen, "A Comparative Study of Two Methods of Teaching Beginning Swimming," (unpublished dissertation, Stanford University).

[13] Dorothy E. Mohr and Mildred E. Barrett, "Effects of Knowledge of Mechanical Principles in Learning to Perform Intermediate Swimming Skills," Research Quarterly, XXXIII (December, 1962), p.574-580.

[14] Iris Lillian Garland, "Effectiveness of Problem Solving Method in Learning Swimming," (unpublished M.S. thesis, Dept. of Physical Education, University of California, Los Angeles, California, 1960) p.90.

gation reveals the following conclusions:

1. Research concerned with the use of water apparatus aids is very limited.

2. Floatation devices used while learning a stroke can be detrimental. Other aids such as music and conscious relaxation can be helpful.

3. Various out-of-water methods of training increase general swimming performance. Controversial material is present concerning their aid to specific factors such as speed.

4. Weight training is beneficial to swimming but specifity of training may bring quicker results.

5. Part progression and whole methods of teaching are superior to the pure-part method.

6. Techniques of problem solving and presentation of the knowledge of mechanical principles governing performance of skills aids in the learning of the skills.

7. From the foregoing a need for further investigation into previous and presently used methods and aids is indicated.

CHAPTER III

PROCEDURE

The subjects in this study were sixteen college freshmen and sophomore girls enrolled in physical education at the University of North Dakota. The subjects participated in two intermediate swimming classes. For the study the subjects were placed in two groups. One group was the experimental group and the other group was a control group. The subjects were tested and timed before a four-weeks training program. Timings were also taken at predesignated intervals during the program and after the program.

Initial skill test

The sixteen girls were chosen for the study after passing a qualifying skill test. The test consisted of flutter kicking in a prone position 250 yards with the use of a kickboard held by extended arms.

Initial timing

Following the skill test a timed 150 yard American Crawl distance swim was administered. According to the results of this test, the students were paired. One of the paired was placed in the experimental group and her counter-part was placed in the control group. The paired subjects had an identical or near identical timing. The writer made an attempt to equate the two groups by the timings. This later proved unsatisfactory.

TABLE 1

EQUATING OF GROUPS

Group Rank	Experimental Group		Control Group	
	Min.	Sec.	Min.	Sec.
1.	3	8	3	13
2.	3	15	3	14
3.	3	20	3	23
4.	3	55	3	25
5.	4	6	3	58
6.	4	14	4	10
7.	5	5	5	5
8.	5	16	5	12

Standard deviation of experimental group	=	146.45
Standard deviation of control group	=	145.39
Differences of standard deviations	=	1.06

Statistical analysis showed they were not statistically equated. (see Table 1 - page 15).

Training program and timings

The training program consisted of three series of seven "five-minute" practice sessions. The experimental group used the "float-a-foot" device during the practice sessions. The control group used the trail-leg method. The subjects were instructed to swim with the American Crawl arm stroke as continuously as possible during the "five-minute" practice sessions.

After each series of the practice sessions a timed 150 yard American Crawl distance swim was administered. For these timings the American Crawl Stroke was performed utilizing the legs as well as the arms. Each subject swam the 150 yards at her best swimming rate and was timed to the nearest second. (see Table 2 and Table 3 - page 15). Throughout the study, participants in both groups were encouraged to progressively improve their timings.

All the subjects participated in the experimental study in conjunction with their university swimming class which met three times per week. Two practice sessions or one practice session and a timing was conducted each class meeting. These sessions took place during the first five minutes of the class activity period and also the final five minutes of the activity time. During the remaining thirty-five minutes of the class activity period the subjects joined other girls to participate in the regular intermediate swimming course. Practice of the American Crawl during this class time and outside of class for both the experimental and control subjects throughout the experimental four-weeks period was prohibited.

When the practice sessions were completed they were checked on a dated chart. Timings for each subject were also recorded on the dated progression chart. From this chart an analysis of data was computed.

TABLE 2

150 YARD DISTANCE SWIM TIMINGS
OF THE CONTROL GROUP

Subject	Initial Timing		Second Timing		Third Timing		Final Timing	
	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
1.	3	13	3	14	3	14	3	15
2.	3	14	3	29	3	26	3	14
3.	3	23	3	18	3	20	2	56
4.	3	25	3	17	3	14	3	17
5.	3	58	4	00	3	58	3	57
6.	4	10	4	13	4	26	3	53
7.	5	05	4	28	4	28	4	01
8.	3	12	4	58	5	15	4	28

TABLE 3

150 YARD DISTANCE SWIM TIMINGS
OF THE EXPERIMENTAL GROUP

Subject	Initial Timing		Second Timing		Third Timing		Final Timing	
	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
1.	3	08	2	57	2	52	2	52
2.	3	15	3	14	3	11	3	04
3.	3	20	3	17	3	19	3	22
4.	3	55	3	53	3	46	3	37
5.	4	06	3	44	3	44	3	31
6.	4	14	3	52	3	35	3	22
7.	5	05	5	53	5	35	4	05
8.	5	16	4	30	4	08	4	08

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

The purpose of this study was to discover whether there are any significant differences between the two groups of intermediate swimmers. The experimental group participated in a training program using a "float-a-foot" device and the control group participated in the same program using the trail-leg method. A more complete explanation of the methods used can be found in Chapter III. Following the collection of the data, it became necessary to choose a means of performing an analysis that would test the significance of the difference between the timings.

Statistical Measure

This investigator assumed the null hypothesis in analyzing the difference between the timings within each group. This hypothesis asserts that there is no true difference between the two mean scores, and that the difference found between sample means is a chance difference and is accidental and unimportant. Investigation of several possible tests of the null hypothesis indicated that the "t" technique for testing the significance of the difference between means derived from correlated scores from small samples was suitable for use in this study.[15] This technique

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[15] Quinn McNemar, Psychological Statistics (New York: John Wily & Sons, Inc., 1949), p.225.

determines the ratio between the mean difference and the estimate of sampling error of the mean difference. This ratio is expressed as "t" and is checked for significance in a "t" table. The value of "t" is proportional to the degrees of freedom (N-1) allowed in determining the relationship between the mean difference and the estimate of sampling error of the mean difference.

For this study, it was decided to retain the null hypothesis up to the .01 level of significance, however, "t" values indicating the .02 or .05 level of significance will be reported as tendencies, which may be worthy of further similar investigation.

Complete data, which includes raw scores, mean differences, and ranges for each group, together with the details of the mathematical process employed in analysis for each test is presented in Appendix B.

Statistical analysis and interpretation of data

The following results were obtained by an analysis of the data collected in this study. The experimental group had a mean score of 242.375 seconds in the initial test and a mean score of 210.125 seconds in the final test. The experimental group had a mean difference of 32.25 seconds decrease between the initial test and final test. The estimate of the sampling error of mean difference was 8.995. The "t" value of 3.585 with 7 degrees of freedom indicated a significant difference at the criterion .01 level.

The control group had a mean score of 237.5 seconds in the initial test and a mean score of 217.625 seconds in the final

test. The control group had a mean difference of 19.875 seconds decrease between the initial test and final test. The estimate of the sampling error of mean difference was 8.409. The "t" value of 2.364 with 7 degrees of freedom indicated no significant difference at the .01 level. However, this difference was significant at the .05 level which shows that improvement was made.

Since the experimental group made significant changes between the initial test and the final test and the control group exhibited a tendency for improvement, it was decided to test further for possible differences between the two groups. The null hypothesis was assumed with respect to the differences between the two groups on values of the mean difference found within the groups between initial and final tests. The null hypothesis was tested in this case by use of the "t" technique for uncorrelated data from small samples.[16]

The mean difference between the initial and final test for the experimental group was 32.25 and for the control group 19.875. The difference between the mean differences of the two groups was 12.375. The estimate of the sampling error for the distribution of the differences between the mean differences was 12.3134. The "t" value resulting from the relationship of the actual difference between the mean differences of the two groups and the estimate of the sampling error for the distribution of the differences between the mean differences was 1.005. With 14 degrees of freedom this "t" value indicated no significant difference

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[16] Ibid. p.223.

between the mean differences found within the experimental and the control groups.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The participants in this study consisted of sixteen college freshmen and sophomore girls enrolled in physical education at the University of North Dakota. The subjects participated in two intermediate swimming classes. For the study the subjects were placed in two groups. One group was the experimental group and the other group was a control group. The subjects were timed before and after a four-weeks training program.

Comparisons were made between the mean differences within each group as indicated by the initial and final tests. The null hypothesis was assumed with respect to the differences within the groups on the initial and final tests. This hypothesis was tested with the "t" technique for the difference between means derived from correlated scores from small samples. Comparisons were also made between the experimental group and the control group by testing the significance of the difference between the mean difference found within the groups. The between groups comparisons used as its testing tool the "t" technique for uncorrelated data from small samples.

Conclusions

(1) A training program carried on for a four-weeks period with the use of the "float-a-foot" device does produce signifi-

cant augmentation of the development of the hand-over-hand arm stroke.

(2) A training program carried on for a four-weeks period with the use of the trail-leg method does produce significant augmentation of the development of the hand-over-hand arm stroke.

(3) Although the trail-leg method showed an advancement of the development of the hand-over-hand arm stroke, the "t" value for testing the significance of within-group differences was greater for the "float-a-foot" device method.

Recommendations

It is recommended that the following considerations be made relative to further study of the use of the "float-a-foot" device as a method of developing arm endurance in swimming the American Crawl:

(1) Further comparisons of the trail-leg and "float-a-foot" methods should be made at other age levels and at a higher ability level using both boys and girls.

(2) A larger number of students should be used in a similiar study.

(3) A comparison of the "float-a-foot" device method with that of a dry-land method of developing arm strength should be conducted to determine the effectiveness of specifity of training.

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