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A Study of the Value of Mechanical Aids in the Teaching/Learning of Swimming with Advanced Swimmers

John R. Cawsey

A STUDY OF THE VALUE OF MECHANICAL AIDS IN THE TEACHING/LEARNING OF SWIMMING WITH ADVANCED SWIMMERS

by
John R. Cawsey

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This thesis submitted by John R. Cawsey in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.

W. C. Koenig
(Chairman)

John L. Quadey

William Johnson
Dean of the Graduate School

Permission

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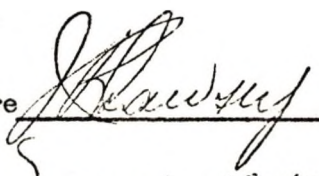
Signature 

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J.R.C.

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ABSTRACT

Problem

This study was concerned with effectiveness of a commercially produced hand-paddle as a teaching/learning aid for learning the arm action of the front crawl swimming stroke.

Procedure

The population was restricted to two classes from the general program at the Advanced Swimmer Level of the Health, Physical Education and Recreation Department of the University of North Dakota. The two samples were randomly divided into experimental and traditional groups. Data were collected by means of a subjective rating instrument designed by the researcher. Students were rated on a pre-test and post-test after eight hours of instruction.

Statistically, the data were treated by using t tests for comparisons both within groups and between groups. An .05 alpha level of significance was selected a priori for the determination of significance in the analyses.

Conclusions

1. The use of the hand-paddles did not result in significantly better performance of the arm stroke in the front crawl than that obtained by subjects using no mechanical aids.

2. The traditional group in Sample Two did not improve significantly and all other groups did during the experimentation period.

Recommendations

1. It is recommended, as a result of improvements found in the data obtained from the Experimental Groups, that a long-range study of the effects of hand-paddles be undertaken.

2. As a result of the significant level of improvement made by the Experimental Groups, it is recommended that coaches and teachers be prepared to use the hand-paddles with some of their students.

3. It is further recommended that tests based on strength, power, endurance, and speed be carried out using the hand-paddles as aids in developing these aspects of various swimming strokes.

4. Since there is now more than one type of hand-paddle available, it is recommended that studies comparing the various types of paddles be initiated.

5. The most important recommendation made by this researcher is that more experimentation be carried out in regard to mechanical learning aids for the recreational swimmer. This could be done at the beginning, intermediate and advanced levels and also over a longer period of instruction.

CHAPTER I

INTRODUCTION

Swimming, like all other athletic pursuits of man, has developed with man and his knowledge not only of himself but also about himself. As the sport, or as one author designated it, Science of Swimming (Councilman, 1968), has developed, so too have stroke patterns. At the turn of the century and for several years thereafter, there was the famous Australian Crawl which now is virtually unknown. Today, it is believed, and, if speed is the criterion, proven, the bent-arm stroke is the most efficient known at this time.

As teachers, coaches and swimmers have sought new and improved ways to learn swimming and stroke patterns, a hand-paddle has been designed to assist in the learning of the bent-arm pull. It is also used to increase strength and power.

Since the hand-paddle was being marketed commercially as an instructional tool, there was a definite need to test the device and the validity of its use.

Statement of the Problem

This study was undertaken to determine if the use of the hand-paddle was warranted and advisable in general swimming classes for a learning aid at the advanced level.

The following terms were used in this study:

A hand-paddle refers to a commercially produced device (known

commercially as Swim Mitt) that is affixed to the hand and automatically increases resistance during the power phase of the bent-arm pull in the front crawl stroke.

The term bent-arm pull refers to a particular method of moving the arms through the water in the front crawl stroke. It is considered the most efficient and effective arm action in the front crawl stroke developed to date.

When using the term power phase, this researcher was referring to the pull-push phase of the arm action, that portion of the stroke from when the arm enters the water until it leaves the water.

Contemporary when used in this study refers to authors within the past twenty year period (1952 to 1972).

The term R.L.S.S., when used, is the recognized abbreviation for the Royal Life Saving Society. Likewise, Y.M.C.A. refers to Young Men's Christian Association. At any time that these two terms, R.L.S.S. and Y.M.C.A., were used they referred to the above organizations.

Traditional group refers to the group of subjects that were given instruction without the use of any mechanical aids.

The term experimental group refers to the group of subjects who were instructed and used the mechanical aid during the instructional period.

Delimitations

1. This study was delimited to the two non-parametric samples consisting of twenty-three (23) and eighteen (18) advanced swimmers.

2. Each sample group was divided by random means into two groups following a test of previous skill learning.

3. Both groups were requested to restrict themselves from any

outside swimming.

4. This study involved only the front crawl swimming stroke.

5. Compulsory attendance was imposed and a close check was maintained to ensure equal instruction for all subjects.

6. A subjective test designed by the researcher after consultation with Arnie Keck (University of North Dakota Swimming Coach) was used.

7. The researcher was the only individual rating the performance of the subjects.

Limitations

1. There was no way of ensuring and maintaining learning readiness of the subjects.

2. The researcher was not able to control the subjects' attitudes on the days of instruction and testing.

3. It was not possible to control diet and the amount of rest obtained by the subjects during the instructional unit on the front crawl.

4. There was no method of ensuring or controlling either levels of physical fitness or endurance on the part of the subjects.

5. Subjects were on a voluntary restriction from outside swimming.

Review of Related Literature

After a careful search, this investigator could find little material written that was directly pertinent to this study. However, many authorities have expressed themselves regarding swimming stroke techniques of the front crawl. Most of the modern writers have advocated the bent-arm pull. Their descriptions and teaching methods have

been most valuable and informative. It was this researcher's intention to test the effectiveness of a hand-paddle as an instructional aid in relation to the learning of the crawl stroke.

William Anderson (1968) was the only contemporary author still advocating a movement that would appear to be representative of the straight arm under-body pull. Anderson described the arm action as:

> The right hand enters the water in front of the shoulder in comfortable reach so that there is a gentle slope from the elbow down to the fingertips. The hand now presses down and back with the arm slightly bent at the elbow until the hand reaches a position directly below the shoulder, when the arm is straightened and the hand continues to drive back to leave the water as the thumb brushes the thigh.

An important aspect to note, however, is that Anderson is describing a stroke technique to be used in teaching the physically handicapped. This could be a possible reason for describing a straight arm under the body pull as opposed to a bent-arm pull.

Stager (1970) and Armbruster et al. (1968) made statements regarding the arm action of the crawl stroke and the overall effect of this action. Armbruster et al. were of the opinion that eighty-five percent of the stroke power came directly from the arm action, while Stager opinionated ninety percent. As a result of opinions such as these, researchers of a more scientific attitude have tested and concluded positive effectiveness of the bent-arm pull (Councilman, 1955; Alley, 1952; Mosterd and Jongblood, 1964).

In the techniques and methodologies reviewed, the majority of authorities were emphasizing the bent-arm pull. Every authority relegated the leg stroke to a secondary, minor or weaker aspect of the front crawl. Stager was of the opinion that the leg stroke provided up to possibly only ten percent of the propulsive power. He also observed

that in some instances, the leg stroke was almost completely eliminated by certain international calibre swimmers, leaving in question the importance of the leg stroke in the front crawl. Colevin (1969) pointed out, and is mentioned here for historical purposes, that, in the 1932 and 1936 Olympics, the Japanese swimmers had exceptionally strong, powerful leg strokes. He also wrote about the type of leg stroke used in sprints, short, middle and long distance swimming as being different according to the distance. Although he did not state a specific amount of power percentage developed from the leg stroke, Colevin did make it quite clear that the leg stroke was secondary to the arm pull.

If coaches and physiologists are concerned with efficiency of stroke mechanics, then how are stroke mechanics to be taught?

Torney and Clayton (1970), Armbruster et al. (1968) and many other individual authors have written instructional texts including teaching progressions for swimming strokes. The various swimming societies (Red Cross, R.L.S.S., Y.M.C.A. and National Lifeguard Society) in their Instructor's Manuals have established teaching progressions and hints. All of these authorities in their methodologies describe the teaching of the bent-arm pull and many give the reasoning behind these techniques (i.e., Councilman, 1968).

Faulkner (1966) in his discussion of swimming stated, "The ultimate criterion of performance, particularly from a competitive viewpoint, is the time required to swim a prescribed distance."

It must be realized that not every person learning to swim is going to swim competitively. Some of the underlying purposes of such societies as the Red Cross, Y.M.C.A. and R.L.S.S. are to teach the general public swimming and water safety. These organizations are

interested in speed swimming but only to the extent that the development of speed assists in the improvement of basic stroke techniques. Rather, the primary purpose of these programs seems to be to help as many people as possible learn to swim effectively and safely for recreational purposes.

In order to achieve these goals, it is necessary that all recreational swimmers be proficient in stroke technique. If a mechanical device can aid in developing the required efficiency, it should be used. Johnson (1964) included some interesting historical background to man's attempted conquest of water. Johnson used a "float-a-foot" to assist in stroke learning. Her results showed the "float-a-foot" to be a positive aid in learning when speed swimming was used as the criterion of measurement. Johnson also found an apparent lack of research concerning the use of apparatus aids in learning and improving swimming strokes.

Some researchers have tried nonmechanical means with success. Dillon (1952) used music successfully to assist in learning swimming skills. Councilman (1963) spoke of dry land practice. Mohr and Barrett (1962) taught intermediate swimmers the mechanical principles involved in the front crawl swimming stroke. Preliminary instruction took place on land prior to the students attempting those skills in the water. Bruce (1961) worked with beginning swimmers in an attempt to develop conscious relaxation. Johnson is the only researcher found to have experimented directly with a mechanical aid at the advanced swimming level.

By what standards will a recreational swimmer's proficiency be judged? Faulkner's measurement criterion of speed was not applicable for recreational swimmers and was therefore eliminated from this study.

Dillon developed an evaluation method that subjectively measured swimming stroke proficiency. Her system was based on visual observations for the purpose of rating proficiency as shown.

Skill Level	Points
Completely failed	0
Unsatisfactory	1-2½
Deficient	3-4½
Satisfactory	5-6½
Good	7-8½
Very good	9-10

Armbruster, Allen and Billingsley (1968) divided the arm action into seven components. These required subjective judgments and were as follows:

a) entry
b) support
c) catch
d) pull
e) push
f) release
g) recovery

Torney and Clayton (1970) used a detailed check list (see Appendix A, page 20) for evaluation which also required much subjective judgment on the part of the evaluator.

Summary of Related Literature

After considerable time and effort, the review of related literature in this investigation has led to the following conclusions.

1. Research concerned with the use of apparatus or mechanical learning aids for teaching swimming is very limited.

2. Several authorities of international recognition such as Councilman, Stager, Gambril and Colevin have done detailed analyses of stroke techniques and have advocated that the bent-arm pull be taught to performers of the front crawl swimming stroke. Organizations such as

the Red Cross, Y.M.C.A. and R.L.S.S. have also advocated the bent-arm technique.

3. Speed and/or distance are the only objective means of measuring a swimmer's stroke proficiency. There is no known standardized method of evaluating swimming performance subjectively.

4. There is a great need for detailed and in-depth research into the use of instructional aids for the learning of swimming skills.

At the time of this writing, this researcher was unable to find a means of evaluation that could be used to produce a standardized, objective evaluation of swimming strokes for recreational swimmers. As a result, this researcher developed a subjective rating scale for the purpose of evaluating proficiency of the arm stroke in the front crawl.

CHAPTER II

METHODOLOGY

Selection of Subjects

Forty-one (41) advanced level swimmers participated in this study as members of two non-probability samples. These samples were selected from advanced level swimming classes from the basic instruction program (non-Physical Education majors or minors) at the University of North Dakota.

Each of the two classes was divided into two groups (experimental and traditional) by using the standard random numbers table for individual placement within groups (Downie and Heath, 1970).

The tester, after an unsuccessful search for an objective instrument, designed a subjective test following consultation with Arnie Keck, the University of North Dakota Varsity Swimming Coach. As an aquatics instructor/examiner the researcher had gained experience and recognition for successful coaching and teaching. He was a Y.M.C.A., R.L.S.S. and Canadian Red Cross Instructor/Examiner. While in the Province of Quebec, he received a merit award from the Canadian Red Cross Water Safety Service for his efforts and achievements as a Water Safety Instructor Trainer/Examiner. Along with several years in competitive swimming as a varsity performer at Macdonald College of McGill University and Loyola of Montreal, he has had six years of successful coaching experience. He coached Canadian Amateur Swimming Association Age Groupers (two Canadian record holders and five provincial record holders),

was varsity swimming coach at Loyola of Montreal and officiated at many swimming meets. His experience and rating as an official enabled him to be starter/head referee at all University of North Dakota home meets including the North Central Conference Championships. This experience and training plus the opinions of the authors reviewed enabled the researcher to design the subjective instrument used in this project.

The subjective test consisted of evaluating and rating only the power phase of the arm action in the front crawl swimming stroke. The decision to use only this phase of the arm stroke came after careful study of opinions and statements made by some internationally recognized coaches such as Stager (1970) and Colevin (1969) who opinionated that the arm action was of more importance than that of the leg in the front crawl swimming stroke for competitive swimmers. Stager opionated that the arm action was ninety percent of the stroke. After careful consideration, it was assumed that the hand-paddles would have very little influence on the recovery of the arms whereas they would probably greatly influence the actual power phase of the arm stroke.

This investigator's division of the power phase of the arm stroke was as follows:

____The forearm is fully extended underwater before the pull phase starts.

____The hand "catches" immediately upon reaching full extension.

____The forearm is flexed during initial and intermediate parts of the pull-push action.

____The hand stays and moves along the center line of the body during the pull-push action.

____The push phase of the stroke is continued by the forearm

until it is fully extended to the thigh.

This rating scale was used on a subjective basis with the subjects receiving one (1) point for each item performed correctly and zero (0) points for each incorrect performance. The five scores for each individual were summated for an overall rating (Tables 1 and 2).

For the pre-test the subjects were required to swim one-hundred yards (four lengths of the pool), one person at a time, while the examiner judged and rated their stroke technique from above the surface. This was done prior to an instructional period of four weeks with classes held twice weekly for sixty minutes each. The results from the pre-test were statistically treated by using a t test for uncorrelated groups (Williams et al., 1969) to determine if there were no significant differences between the groups.

Training Program and Testings

All the subjects were instructed by the researcher using the whole-part-whole method as well as introducing the mechanical principles for the front crawl swimming stroke. Each member of the experimental groups was issued hand-paddles and told to swim sets of one-hundred yards alternating between using paddles and without paddles. A rest period of twenty seconds was allowed between sets. The traditional groups were similarly instructed to swim sets of one-hundred yards without the use of paddles. Similar rest periods were allowed between sets. The instructor, by means of an elapsed timer, limited himself to five minute instruction-correction periods for each group following the combined large group instructional time at the beginning of each class period.

At the end of the instructional unit on the front crawl swimming

stroke, all students were tested and rated. The manner of testing and rating was the same procedure as followed on the pre-test.

The results were statistically analyzed for significance using the t test for small uncorrelated groups (Williams et al., 1969). To establish the level of significance, the .05 alpha level was chosen a priori.

CHAPTER III

ANALYSIS AND INTERPRETATION OF DATA

Statistical analysis for this study was accomplished by the use of t tests for uncorrelated groups to determine whether or not there were significant differences between the means of the traditional and the experimental groups on the pre- and post-test results. The collected data was also examined for within group significance on the pre- and post-test by the use of a t test for related groups.

The results for Sample One are reported in Table 1.

Data analysis for the uncorrelated groups was accomplished through the following equation:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\Sigma X_1^2 - \frac{(\Sigma X_1)^2}{n_1} + \Sigma X_2^2 - \frac{(\Sigma X)^2}{n_2}}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

TABLE 1

RATED SCORES

Traditional				Experimental			
Pre-test	Post-test	D	D^2	Pre-test	Post-test	D	D^2
1	2	1	1	0	2	2	4
3	3	0	0	1	4	2	4
1	3	2	4	2	3	1	1
2	4	2	4	1	4	3	9
2	2	0	0	2	4	2	4
1	2	1	1	2	3	1	1
3	3	0	0	1	3	2	4
0	0	0	0	2	3	1	1
2	4	2	4	1	4	3	9
0	0	0	0	1	3	2	4
1	4	3	9	2	2	0	0
				0	2	2	4
$\Sigma X_1 = 16$	$\Sigma X_1 = 27$	$\Sigma D_1 = 11$	$\Sigma D_1^2 = 23$	$\Sigma X_2 = 15$	$\Sigma X_2^2 = 38$	$\Sigma D_2 = 21$	$\Sigma D_2^2 = 45$
$\Sigma X_1^2 = 256$	$\Sigma X_1^2 = 729$			$\Sigma X_2^2 = 225$	$\Sigma X_2^2 = 1444$.		
$\bar{X} = 1.45$	$\bar{X} = 2.45$	$\bar{D}_1 = 1.22$		$\bar{X}_2 = 1.36$	$\bar{X}_2 = 3.17$	$\bar{D}_2 = 2.33$	

The following results were reached when the data from the pre-test were analyzed for significant differences prior to the instructional unit.

$$t = \frac{1.45 - 1.36}{\sqrt{\frac{(16)^2 - \frac{(16)^2}{11} + (15)^2 - \frac{(15)^2}{12}}{11 + 12 - 2} \frac{1}{11} + \frac{1}{11}}}$$

$$t = \frac{.09}{\sqrt{\frac{256 - \frac{256}{11} + 225 - \frac{225}{12}}{21} \frac{23}{132}}}$$

$$t = \frac{.09}{\sqrt{\frac{438.98}{21}\left(\frac{23}{132}\right)}}$$

$$t = \frac{.09}{1.88} = .04$$

To be significant at the .05 level with twenty-one (21) degrees of freedom, a value of 2.10 was required. From this computation, it was shown that there was no significant difference between the two groups of Sample One on the pre-test prior to instruction.

By using a within group comparison, the results of each group were analyzed to check for significance between the pre- and post-tests for the learning of the front crawl swimming stroke. Sample One, Traditional Group was as follows:

Sample One, Pre-Post Comparisons

Traditional Group

$$S_{\overline{D}} = \frac{\sqrt{\frac{D^2 - \frac{(D)^2}{n}}{n-1}}}{\sqrt{n}}$$

$$S_{\overline{D}} = \frac{\sqrt{\frac{23 - \frac{(11)^2}{11}}{11-1}}}{\sqrt{11}}$$

$$= \frac{\sqrt{\frac{23 - \frac{121}{11}}{10}}}{\sqrt{11}}$$

$$= \sqrt{\frac{\frac{12}{10}}{3.31}}$$

$$= \frac{1.09}{3.31} = .33$$

$$t = \frac{\bar{D}}{S_{\bar{D}}}$$

$$= \frac{1.22}{.33} = 3.70$$

The t value of 3.70 was significant at the .05 alpha level; therefore, the traditional group of Sample One did make significant improvement in developing the arm stroke of front crawl swimming stroke during the experimental period.

With the experimental group of Sample One the following results were obtained from a pre-post within group comparison:

$$S_{\bar{D}} = \frac{\sqrt{\frac{45 - \frac{(21)^2}{12}}{12 - 1}}}{\sqrt{12}}$$

$$= \frac{\sqrt{\frac{45 - \frac{445}{12}}{11}}}{\sqrt{12}}$$

$$= \sqrt{\frac{\frac{7.75}{11}}{3.46}}$$

$$= \frac{.69}{3.46} = .19$$

$$t = \frac{\bar{D}}{S_{\bar{D}}}$$

$$t = \frac{2.33}{.19} = 12.26$$

Since a t value of 2.23 was required at the .05 level with ten

(10) degrees of freedom, there was significant improvement in the experimental group of Sample One.

In analyzing the post-test data between the traditional and experimental groups of Sample One, the following statistical analysis was computed:

$$t = \frac{2.45 - 3.17}{\sqrt{\frac{729 - \frac{(27)^2}{11} + 1444 - \frac{(38)^2}{12}}{11 + 12 - 2}\ \frac{1}{11} + \frac{1}{11}}}$$

$$t = \frac{-.72}{\sqrt{\frac{1984.40}{21}\ \frac{23}{132}}}$$

$$t = \frac{-.72}{\sqrt{15.60}}$$

$$t = \frac{-.72}{3.95} = .18$$

To be significant at the .05 level with twenty-one (21) degrees of freedom a t value of 2.10 was required. Since the value obtained (.18) did not meet the significant level, the null hypothesis was retained.

The same statistical procedures were used for an analysis of the data from Sample Two.

In order to analyze for significance between group one and group two within Sample Two, the same t test was used. The results from the pre-test comparison are as follows:

$$t = \frac{1.22 - 1.22}{\sqrt{\frac{(11)^2 - \frac{(11)^2}{9} + (11)^2 - \frac{(11)^2}{9}}{9 + 9 - 2}\ \frac{1}{9} + \frac{1}{9}}}$$

TABLE 2

SAMPLE TWO

Traditional				Experimental			
Pre-test	Post-test	D	D^2	Pre-test	Post-test	D	D^2
1	5	4	16	0	2	2	4
0	2	2	4	1	4	3	9
1	2	1	1	1	2	1	1
0	2	2	4	1	3	2	4
1	2	1	1	2	4	2	4
1	4	3	9	1	4	3	9
2	2	0	0	1	1	0	0
2	3	1	1	2	2	0	0
3	4	1	1	2	3	1	1
$\Sigma X_1=11$	$\Sigma X_1=26$	$\Sigma D_1=15$	$\Sigma D_1^2=27$	$\Sigma X_2=11$	$\Sigma X_2=25$	$\Sigma D_2=14$	$\Sigma D_2^2=32$
$\Sigma X_1^2=121$	$\Sigma X_1^2=676$			$\Sigma X_2^2=121$	$\Sigma X_2^2=625$		
$\bar{X}_1=1.22$	$\bar{X}_1=2.89$	$\bar{D}_1=1.67$		$\bar{X}_2=1.22$	$\bar{X}_2=2.78$	$\bar{D}_2=1.56$	

$$t = \frac{0}{\sqrt{\frac{(121) - \frac{(121)}{9} + 121 - \frac{121}{9}}{16}}}$$

$$t = 0$$

It was shown that there was no significant difference between the groups in Sample Two prior to the instructional period.

The amount of improvement within the groups of Sample Two was also measured. Those results were:

Traditional Group

$$S_{\bar{D}} = \frac{\sqrt{\frac{27 - \frac{(15)^2}{9}}{9 - 1}}}{\sqrt{9}}$$

$$= \sqrt{\frac{27 - \frac{225}{9}}{\frac{8}{3}}}$$

$$= \sqrt{\frac{\frac{2}{8}}{3}}$$

$$= \frac{.5}{3} = 1.67$$

$$t = \frac{\bar{D}}{S_{\bar{D}}}$$

$$t = \frac{1.67}{1.67} = 1.0$$

At the .05 alpha level a t value of 2.31 was required for eight (8) degrees of freedom. The obtained t (1.0) was not significant; therefore, there was not a significant amount of improvement by the Traditional Group of Sample Two.

Experimental Group

$$S_{\bar{D}} = \frac{\sqrt{32 - \frac{(14)^2}{9}}}{\sqrt{9 - 1}}$$

$$= \sqrt{\frac{32 - \frac{196}{9}}{\frac{8}{3}}}$$

$$= \sqrt{\frac{1.25}{3}}$$

$$= \frac{1.12}{3} = .37$$

$$t = \frac{\bar{D}}{S_{\bar{D}}}$$

$$t = \frac{1.56}{.37} = 4.22$$

Since the t value obtained (4.22) was greater than the required t of 2.31 for eight (8) degrees of freedom, there was significant improvement within the Experimental Group of Sample Two.

Following the instructional unit of the front crawl, the data from Sample Two were analyzed as follows:

$$t = \frac{2.89 - 2.78}{\sqrt{\frac{(26)^2 - \frac{(26)^2}{9} + (25)^2 - \frac{(25)^2}{9}}{9 + 9 - 2}\left(\frac{1}{9} + \frac{1}{9}\right)}}$$

$$t = \frac{.11}{\sqrt{\frac{676 - \frac{(676)^2}{9} + 625 - \frac{(625)}{9}}{16}\left(\frac{2}{9}\right)}}$$

$$t = \frac{.11}{\sqrt{\frac{1256.56}{16}\left(\frac{2}{9}\right)}}$$

$$t = \frac{.11}{4.16} = .03$$

At the .05 alpha level a t value of 2.14 was required for sixteen degrees of freedom. Since the obtained t value of .03 was not significant, there was no difference between the experimental and traditional groups based on the results of post-tests.

CHAPTER IV

DISCUSSION

While searching to complete the review of literature, it became obvious that there has been little research done directly related to the recreational swimmer and even less concerning aids for actually teaching or learning the swimming strokes. The majority of studies reviewed were concerned with speed swimming and were based on principles of physiology of exercise. In some articles and texts, there were kinesiological bases given for the use of the bent-arm pull. There have been studies which verify the efficiency of this method as opposed to other techniques (Alley, 1952). Many of the instructional manuals pointed out the difficulties and problem areas of learning this technique (Torney and Clayton, 1970 and Canadian Red Cross Water Safety Instructor's Guide, 1969) but there seemed little indication of what to look for when evaluating or attempting to improve stroke technique.

There have been studies involving methodologies designed to help the student learn easier and faster (Mohr and Barrett, 1962). Since the hand-paddle came on the commercial market, it has not reportedly been put to any experimental tests regarding its value as a learning/teaching aid. Since the results of this study show that one of the traditional groups did make significant improvement and that there were no significant differences between either of the experimental and traditional groups based on post-test data, these results scarcely support some of the advertising claims made by the hand-paddle manufacturer.

This study is by no means completely conclusive, either affirmatively or negatively regarding hand-paddles. Perhaps by extending the time of the instructional unit, or using the paddles at the beginner level, or by training by different techniques, the test results may have been different.

If it had been possible to use a panel of judges for the rating, along with a much more detailed rating instrument, there may have been different results. The main problem involved with the use of a panel of judges would have been the unavailability of an instrument that would meet minimal standards of objectivity and validity. A subjective rating instrument could have been used by a panel, but a great deal of training would have been required after the selection of the judges had been completed.

With the use of the instrument developed for this study, a more precise measurement may have been obtained by judging each item on a five point basis rather than a one point pass/fail basis.

Although there was improvement, it was not of a significant nature when the two groups (traditional and experimental) were compared. In both samples, however, the Experimental Groups had significant improvement when the pre-post test results were analyzed, while only the Traditional Group data from Sample One indicated significant improvement. The lack of a significant level of improvement when comparing the Traditional Groups' to the Experimental Groups' results may have been as a result of two aspects of the study. Since there were only eight (8) hours of instruction with subjects meeting only twice (2) weekly, it may have been insufficient time to develop proficiency significantly for all subjects. Possibly by either increasing the number of instructional

hours and by meeting three (3) times weekly or daily, the difference of improvement between the groups might have been greater. It may also be that when using a mechanical teaching/learning aid, beginning level swimmers should be used because the level of improvement will be greater and more noticeable over the shorter period of time.

It was also observed by the researcher that there was a great difference in attitudes between the two samples. This attitudinal difference ranged from great interest and enthusiasm to that of apparent boredom and complete disinterest. Had all subjects been interested in the study the results may have been different.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The problem in this study was to test for significance the results obtained after evaluating the front crawl swimming stroke performance of two non-parametric groups. One group was taught by using traditional methods and the other, an experimental group, used a commercially produced hand-paddle as an instructional aid.

It was found that there had been no previous directly related research done on this problem.

For this study, two classes from the basic instructional program of the University of North Dakota's Physical Education Program were used as non-parametric samples. They were both advanced level swimming classes consisting of twenty-three (23) and eighteen (18) students, respectively.

Prior to and following an eight (8) hour instructional period, individual subjects in each sample were tested. The results showed that there were no significant differences between groups of either samples' stroke performance in the front crawl on either the pre- or post-testing.

Conclusions

1. The use of the hand-paddles did not result in significantly better performance of the arm stroke than that obtained by subjects using no mechanical aids.

2. The traditional group in Sample Two did not improve significantly and all other groups did during the experimentation period.

Recommendations

1. It is recommended, as a result of improvements found in the data obtained from the Experimental Groups, that a long-range study of the effects of hand-paddles be undertaken.

2. As a result of the significant level of improvement made by the Experimental Groups, it is recommended that coaches and teachers be prepared to use the hand-paddles with some of their students.

3. It is further recommended that tests based on strength, power, endurance, and speed be carried out using the hand-paddles as aids in developing these aspects of various swimming strokes.

4. Since there is now more than one type of hand-paddle available, it is recommended that studies comparing the various types of paddles be initiated.

5. The most important recommendation made by this researcher is that more experimentation be carried out in regard to mechanical learning aids for the recreational swimmer. This could be done at the beginning, intermediate and advanced levels and also over a longer period of instruction.

Fig. 1.--Performance Analysis Sheet for the Front Crawl Swimming Stroke (Torney and Clayton, 1970).

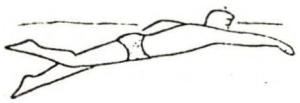
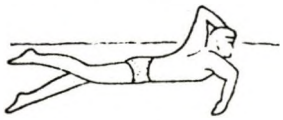
APPENDIX A

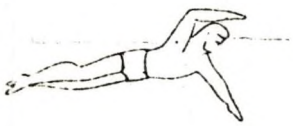
PERFORMANCE ANALYSIS SHEET FOR THE FRONT CRAWL STROKE*

DIRECTIONS: Check ✓ all items that apply to the performance of this skill. Add other noted errors in the spaces provided.

NAME _____
(performer)

NAME _____
(analyzer)

Illustrations of Correct Techniques	Analysis of Performance
	**BODY POSITION** ____The form *is* acceptable. ____The form is *not* acceptable because: ____Face not looking ahead underwater. ____Head too deep in the water. ____Head held above the surface. ____Back overarched. ____Hips higher than the legs. ____(Other)_____
	**LEGS** ____The form *is* acceptable. ____The form is *not* acceptable because: ____Too much bend at the knees. ____Not enough bend at the knees. ____Kick range too narrow (less than 12-15"). ____Too much splash. ____Toes not pointed with ankles extended. ____(Other)_____
	



ARMS

_____The form *is* acceptable.

_____The form is *not* acceptable because:

- _____Arm not bent during recovery.
- _____Arm not relaxed during recovery.
- _____Arm thrust rather than swung from shoulder.
- _____Elbow not higher than hand during recovery.
- _____Elbow enters water before hand enters.
- _____Hand enters water in front of opposite shoulder.
- _____Hand enters water in front of face and pushes forward before pulling back.
- _____Arm does not pull through under body.
- _____Elbow not bent when pull-push is executed.
- _____Pull-push of arms too short.
- _____(Other)_____

COORDINATION AND BREATHING

_____The form *is* acceptable.

_____The form is *not* acceptable because:

- _____Arms and legs work independently.
- _____Arm action not rhythmic (swimmer gallops).
- _____Head lifted for breathing rather than rolled to side.
- _____Breath taken in during late stage of arm recovery.
- _____Kick and arm stroke stopped while breath is taken.
- _____Head turned from side to side.
- _____(Other)_____

*Method by Barbara J. Sanborn.

BIBLIOGRAPHY

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Alley, Louis E. "An Analysis of Water Resistance and Propulsion in Swimming the Crawl Stroke." Research Quarterly, Vol. XXIII (October, 1952).

Amateur Swimming Association. Swimming Instruction. London: Educational Productions Ltd.

American Red Cross. Water Safety Instructor's Manual. Washington, D.C.: 1968.

Anderson, William. Teaching the Physically Handicapped to Swim. London: Faber and Faber Ltd., 1968.

Armbruster, David A.; Allen, Robert F.; and Billingsley, Hobert Sherwood. Swimming and Diving. St. Louis: The C. V. Mosby Company, 1968.

Bruce, Patricia J. "The Effects of Conscious Relaxation and a Floatation Device on Learning Beginning Swimming." Unpublished P.E.D. dissertation, State University of Iowa, 1961.

Canadian Red Cross Society Water Safety Service. Instructor's Guide and Reference. Toronto: 1969.

Colevin, Cecil. On Swimming. London: Pelham Books Ltd., 1969.

Councilman, James E. Research Quarterly, XXVI (1955) 127-39.

_____. "A Dry Land Exercise Program for Swimmers." Paper read before the research section of the 1963 National AAHPER Convention, Minneapolis, Minn., May, 1963.

_____. The Science of Swimming. Englewood Cliffs: Prentice-Hall, 1968.

Dillon, Evelyn K. "A Study of the Use of Music as an Aid in Teaching Swimming." Research Quarterly, Vol. XXIII (October, 1952).

Downie, N. M., and Heath, R. W. Basic Statistical Methods. New York: Harper and Row Publishers, 1970.

Faulkner, John A. "Physiology of Swimming." Research Quarterly, Vol. XXXVII (March, 1966).

Gabrielson, M. Alexander; Spears, Betty; and Gabrielson, B. W. Aquatics Handbook. Englewood Cliffs: Prentice-Hall, Inc., 1970.

Gambril, Donald L. Swimming. Pacific Palisades: Goodyear Publishing Company, 1969.

Gold, M., and Waglow, T. F. "Swimming Classification Text." Research Quarterly, Vol. XXVI, No. 4 (1955).

Johnson, Joann White. "A Comparison of Two Methods of Developing Arm Endurance in Swimming the American Crawl." Unpublished M.Ed. thesis, University of North Dakota, 1964.

McNemar, Quin. Psychological Statistics. New York: John Wiley and Sons, Inc., 1949.

Mohr, Dorothy R., and Barrett, Mildred E. "Effect of Knowledge and Mechanical Principals in Learning to Perform Intermediate Swimming Skills." Research Quarterly, Vol. XXIII, No. 4 (December, 1962).

Mosterd, W. L., and Jongblood, J. "An Analysis of the Stroke of Highly Trained Swimmers." Arbeitsphysiol, Vol. XX (1964).

Royal Life Saving Society. Instructor's Handbook. Toronto: 1968.

Stager, A. D. (Gus). Swimming Coaching Clinic, University of North Dakota, 1970.

"Swimming World and Junior Swimmer," Vol. XII, No. 3 (March, 1971). 12618 Killian Street, North Hollywood, Calif. 91607.

Torney, John A., and Clayton, Robert D. Aquatics Instruction, Coaching and Management. Minneapolis: Burgess Publishing Company, 1970.

Williams, John D.; Harlow, Steven D.; and Houston, Samuel R. Action Research for the Classroom Teacher. Dubuque: Kendall/Hunt Publishing Company, 1969.