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# The Influence of Anthropometric Indices on Execution Technique Specific to Crawl Swimming for Students of Physical Education and Sport Specialization

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## Abstract

The aim of the study was to establish the level of learning and performance of the crawl technique, taking into account the hydrodynamic index and the anthropometric characteristics, as a result of practical swimming lessons, with students of first year, specialization physical education and sport. The Experiment was conducted during the academic year 2015-2016 and included a total of 18 students, boys between the ages of 19-22 years, first year, physical education specialization. Motor skills tests which were applied targeted: the length of facial floating with a push from the wall and the length of time performed on 25 metres distance in the crawl swimming stroke. Anthropometric measurements consisted in the determination of the hydrodynamic index taking into account the biacromial and bitrohanterial diameters and the difference between the wingspan of the arms and height. At the end of the study the floating facial test has recorded a progress of 0.29 m and the test concerning the execution technique of the crawl stroke has recorded a progress of 1.65 h, which in correlation with the hydrodynamic and anthropometric indices led to the conclusion that this is due, in particular, to the execution technique corrected by the methodology applied to the classes of practical works at swimming discipline. Performing practical lessons at the swimming subject unfolded over the course of a university semester reaches the goals of improving knowledge of teaching methodology to a great extent but it equally shows a deficit at the level of physical performance of the future specialists. Following the application of the selected means of action and the choice of an efficient teaching strategy in both tests which aimed at the execution technique indices of the crawl stroke a significant progress was made.

**Keywords:** crawl stroke, technique, anthropometry, buoyancy

## Introduction

This study aims to analyze two aspects: one is to what extent anthropometric indices as well as the arm wingspan and the height can influence the degree of floatability in the facial gliding and second, what influence has the hydrodynamic index calculated on the basis of biacromial and bihanterial diameters which influences the execution technique of the crawl stroke on a certain distance.

There is a direct interrelation between the physiological capacity mechanisms and the practical level of physical exercise, which is influenced by a series of factors, of which environment and its characteristics is the most important (A. Badau et al, 2015, pag. 236)

In the framework of the subject Teaching swimming for the first year I, which runs throughout 14 weeks , one lesson per week , 60 minute- length of time, we aim to convey and to put into practice as many concepts as possible specific to the teaching of the swimming techniques, taking into account some aspects such as the methodology of teaching, the selection of the means of action that are to be applied, the sequence of learning elements of the technical components of each process, related to the level of physical training; the age of the future students and certain anthropometric indices.

What the university curricula also provide students with is learning the correct movements, specific to each method of swimming.

Promoting the benefits and content of various leisure physical activities through an extensive permanent and updated campaign, with modern scientific share in the field of motor activities will contribute significantly to optimizing human potential improvement. (Badau, et al, 2012)

According to the authors Camarda A. L. and Enoiu M. on the operational teaching strategies, they state that"they allow for the focus of the educational activity on the student, stimulating his creative independent thinking, and on the selection of values, self-confidence in assessing situations, rapidity and high capacity of argumentation and justification " (2008, pg. 104).

The applicability of the theory in the effective practice requires from the future specialists, a complete picture of the sequence and the execution technique of the component elements of the swimming processes, to which it will necessarily be added the effective work with groups of people; this will be done as a rule only after graduation, because the number of hours allocated does not meet this component of the teaching process.

Students with specialization in physical education which will later be the future specialists, in order to assimilate the theoretical-methodical information should have a proper swimming technique, since the volume of information of each lesson is great.

Studies on certain specific features of swimming for the students in physical education and sports specialization were made by Ewa Dybińska, Marcin Kaca in 2007, aiming at the motivational component aspect and Bojan Jorgić et al., in 2009 who studied students flexibilty to practical courses, etc.

"The possibilities of the aquatic environment can constitute as a benefit to the active level of physical activities and as a key contribution to health and agreement, that derive from its special features, acting at functional and aesthetic levels " (Badau A., Badau D., 2011, pg. 4).

Practised in an academic environment, swimming today becomes a requirement with choices and large sanogenetic applications due to the students' specific work, where physical exercise

occupies a small part of the students' time as opposed to the prevalence of mental and intellectual pursuits and stress (Stoica A., 2009).

In 2008 Statkevičienė B. and collab, conducted a study that targeted the level of performance in different swimming techniques correlated with anthropometric indices for the young people aged 18 (years).

Starting from this idea we have considered that correlating these two aspects to which we also added the hydrodynamic index, we believe it will be an argument in favour of the originality of this research.

Hypothesis: By applying the methodology assigned in the curricula at the level of first year students in physical education specialization, we can obtain an improvement of the technical level of execution in crawl stroke and facial gliding which can be also influenced by anthropometric indices as well as by the hydrodynamic index.

## Material and methods

*Period and place of the research*

The experiment was conducted during the first semester of the academic year 2015-2016, for a period of 14 week, the allocated time for each practical class specific to the swimming subject has been of 60 minutes for each group.The classes took place at the spa center of Tirgu Mures University of Medicine and Pharmacy which is specially designed so it can allow for swimming courses. The length of the pool is 25 meters equipped with 4 swimming corridors, and a depth ranging from 1.6-2.5 meters.

The anthropometric measurements were performed only before the start of the first swimming hour, which constitutes their evaluation because these indices do not change within such a short amount of time, considering that our subjects are at their complete somatic development and the differences which might occur are insignificant in relation to their specific training.

The initial testing of facial gliding was done at the end of the second hour, because in the first class a consolidation and a correction of the execution technique were achieved; the final testing was done during the last hour at the end of the semester.

Crawl initial testing on a distance of 25 metres- a race against clock- was done in the fourth hour of practical works after completing the learning classes and the final testing was done in the last class of the semester, i.e. the week 14. We mention the fact that all the subjects acquired a satisfactory technical level of execution of the crawl stroke.

Throughout the semester, students kept practising this procedure, even if in every lesson they still had to learn new technical and methodological things and other specific elements to other aimed technical procedures.

*Subjects and groups*

The subjects of our research are freshmen- first year students from physical education and sport specialization within the Motricity Sciences subject. The experiment comprised a total of 18 students, who were split into two groups of 9 subjects, excluding the girls. Their age is between 19-22 years old, and the sports they practiced before university were: football, basketball, volleyball, karate. We mention that no subject has previously practiced strictly water sports and has not competed in any specific competition. The applied methodology on

both groups was identical as it is provided for in the university curricula for this subject at this value and educational level.

*Tests and measurements applied*

The applied measurements have targeted somatic indices: height, the arm wingspan – which represents the distance between the tip of the right and the left medius, with the arms horizontally outstretched at the level of the collarbones. It is used in the performance sport in direct connection with the completion of the effort .Its length must be at least equal to stature.

The difference between the height and the arm wingspan helps us to determine the positive, neutral or negative characteristics of the subjects, which in the case of the swimmers must be positive in order to get the best results.

The practice and the specialty literature reflect the fact that the wingspan landmark should be 104-106% of the waist for high performance athletes. Considering that our sample subjects perform other sports than swimming, this value represents only a landmark of proportionality that can influence the results of the applied tests.

We have also measured the biacromial and bitrohanterian diameters which helped us to determine the hydrodynamic index which influences the floating degree- the body floatability which is influenced by the structure and the harmony of the body.
The biacromial diameter represents the distance between the distal points on the outer edge of the acromion. A biacromial diameter is longer than 43 cm for men. The bitrohanterian diameter - represents the pelvis width and it is measured transversely on the outer anteroexternal edge of the large trochanters. It is generally 4-5cm lower than the biacromial diameter and it can vary to a large degree.
From the numerical comparison of the two diameters,it results the athletic look (wide chest, narrow pelvis); the maximum values are 10-12cm, very good values are ≥ 25 cm and good values are considered between 20-25 cm .

The so-called hydrodynamic index specific to swimming was calculated:
IH = (y x 100)/stature in cm, with good values over 25

y = (the biacromial and bitrohanterian diameters)/2

We have also applied two tests targeting the motor skills level specific to crawl stroke through its components: the facial gliding and the distance run against the clock which outlines the level of individual technicality.

Gliding and sliding with a push off the pool wall. The execution technique is: standing on one foot and the other foot is bent and fixed to the pool wall; the swimmer takes a deep breath leaving the body under the water after which he performs a strong push in the pool wall gliding on the water with his arms outstretched. The distance he swims is measured in meters. It was taken into account the distance from the wall to the first heel that was sunk more than 15 inches into the water. The tape measure was placed on the edge of the pool and the depth was approximatively calculated with the help of a swimming pool interior edge which was 10 centimeter deep.
Crawl swimming on 25 meter length, with the start from the water –the recorded time is measured in seconds. The start was made according to the subject movement and the stopwatch was made when the subject reached the opposite wall of the swimming pool by his hand.

*The applied methodology:*

Following the curricula for this subject we achieved a planning of the elements students learned and practised throughout a semester. If during the first 4-5 classes a consolidation and a correction of the specific elements to crawl were achieved, it was further practiced both in the warm-up stage and at the end of the classes with high indices of correctness and efficiency.

**Table 1.** Lesson planning process methodology for teaching students crawl

| Thematic classes /lesson number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preparatory drills in water, facial gliding/testing | x | x | | | | | | | | | | | | |
| | | TI | | | | | | | | | | | | TF |
| Back gliding | | x | | | | | | | | | | | | |
| Freestyle leg movements | | x | x | | | | | | | | | | | |
| Freestyle arm movements | | | x | x | x | | | | | | | | | |
| Breath | | | x | x | x | x | | | | | | | | |
| Arms, legs and breath coordination/ | | | | x | x | x | x | x | x | x | | | | |
| | | | | TI | | | | | | | | | | TF |
| testare | | | | | | | | | | | | | | |
| Perfecting the swimming style technique | | | | | | | | | | | x | x | x | TF |

The teaching-learning program within the Teaching swimming subject presented in Table. 1. began with two classes of training exercises in which we emphasized the exercises for gaining water confidence and learning facial gliding. At the end of the second lesson we applied the first test on the facial floating length value representing the initial testing.

After mastering the motor skill of facial and dorsal gliding and the methodology of teaching, we continued explaining the movement of the legs which can relatively quickly be learned and that is also part of adaptation exercises performed by the pool edge at the beginning of the class.

Starting from the third lesson we practised the arm movement specific to crawl stroke that is more complex, perfecting it over three hours. Since the arm movement can not be appropriated without a right body position on water, we synchronized it with the breathing exercises specific to crawl, which enabled us that at the end of the 4th hour to perform an initial testing of the speed of the crawl process. After mastering the technical elements of the process, in the following weeks we achieved the consolidation of the technique and of the teaching concepts.

## Results and Discussions

The Anthropometric measurements performed revealed the following results:

**Table 2.** Centralizing values of anthropometric indices

| | ***Anthropometric indices*** | | | | | | |
|---|---|---|---|---|---|---|---|
| Values | Height(H) | Span | Span Dif. H- | Biacromial diametre | Bichanterial diametre | Y | IH |
| ∑ | 3233 | 3250 | 17 | 688.5 | 551 | 621.25 | 345.90 |
| X | 179.61 | 180.56 | 0.94 | 38.25 | 30.61 | 34.51 | 19.22 |

H- height; IH –hydrodinamic index

As seen in table 2. the wingspan landmark by height is calculated for our sample group to105%, so it falls into the athletic look which can lead to positive results by practising swimming.

Also with one exception, which recorded a negative difference calculated between height and arm wingspan, four of the sampled group had the score, O "means the values being identical, the other subjects recorded positive values between 1-3 cm. The average value of this group to the height and arm indicator is 0.94 cm. a good value considering the practised sport.

After analyzing the values of body diameters it was found that they respect the rule of proportionality fitting in an average of differences of 3.9.cm.

By calculating the hydrodynamic coefficient index through Y coefficient, it has been found that its level was below the average level of performance, recording only19.22, value that can be justified by subjects specialization other than swimming.

The difference between the bihanterial and biacromial diameter recorded a value of 7.64 cm. suggesting an athletic look of the group, but still below the required maximum values of the swimming stroke.

We present the scores obtained after the specific swimming tests/ events we have applied:

### *Facial gliding*

**Table 3.** Centralizing scores of facial gliding event/ test

| Coefficients | TI | TF |
|---|---|---|
| Minimum | 3.200 | 3.500 |
| Maximum | 4.900 | 5.300 |
| Mean | 4.039 | 4.321 |
| Std. Deviation | 0.4303 | 0.4457 |
| t, df | t=39.33 df=17 | t=40.66 df=17 |
| P value (two tailed) | | < 0.0001 |
| Coefficient of variation | 10.65% | 10.31% |
| Sum | 72.70 | 77.78 |

In this test aiming at the length of facial gliding, the difference between the final testing and the initial one recorded a progress to all the subjects of the test, with an average value of 0.29 meters, justified by the improvement of the technical level of execution provided by the methodology we have correctly selected and applied.

While the minimum value at the initial testing was 3.2 m, in this final testing it was 3.5 m.

Following the statistical and mathematical analysis by applying the t-Student test and index p calculation, at a significance threshold of 0.05 comparatively calculated in both tests, the progress is highly significant for the sample group, which confirms the hypothesis and rejects the null hypothesis.

The coefficient of variation is good which means that dispersion was relatively small.

Correlating the hydrodynamic index with the facial gliding length it is found that they influence each other, namely: even if the average value of floatability is low- for swimming this value is 19, 22 compared to the average of minimum 20 and the average gliding length recorded a relatively small value of only 0.29 m, we still consider it sufficient taking into account both the training period and the specialization of the young students.

The progress in this event is largely due to learning a technique with higher indices of this element - facial gliding compared with the technique subjects previously knew.

The scores support the assertions of Badau et all, (2009) si anume "under the beneficial influence of physical exercise, trough a more intense activity, in the body the capillary reserves open and new ones are formed. Apart from capillary multiplication, muscular fibers develop leading to the appearance of a harmonious muscle mass and a good effort capacity (

## Crawl swimming 25 metres

**Table 4.** Centralizing scores of crawl swimming event/ test against clock on 25 metre-distance

| Coefficients | TI | TF |
|---|---|---|
| Minimum | 19.23 | 18.61 |
| Maximum | 25.56 | 24.60 |
| Mean | 22.65 | 21.01 |
| Std. Deviation | 2.069 | 1.986 |
| t, df | t=46.44 df=17 | t=44.88 df=17 |
| P value (two tailed) | | < 0.0001 |
| Coefficient of variation | 9.13% | 9.45% |
| Sum | 407.7 | 378.1 |

In the swimming crawl event on 25 m distance with the start in the water, all subjects recorded a progress, mainly highlighted by the difference between the arithmetic mean of testings which recorded a value of 1.65 sec.

This progress is exclusively due to the improvement of personal techniques achieved within the practical works at the swimming subject.

While the maximum value at the initial testing was 25.56 sec, in this final testing it was reduced by 0.96 sec, the progress is due to both practicing this stroke within classes and of finishing execution techniques.

The coefficient of variability is good, the dispersion is relatively small justified by the subjects specialization who didn't practice performance swimming.

In order to confirm the hypothesis we also applied t-Student test at a significance threshold of 0.05 which recorded a strong progress $p< 0.001$.

Comparing the scores of the specific tests applied to swimming with the anthropometric indices we found that they are not relevant, influencing to a lesser extent the execution technique and implicitly the scores in crawl swimming test, as the finish time is not so remarkable.

Correlating the values of this execution technique test in crawl swimming with the difference between the arm wingspan and the height, which is predominantly positive to our subjects, we found that although a temporary progress was recorded we believe it is predominantly due to the methodology we applied and to the means of action we chose and used that have positively influenced the execution technique.

This statement is also supported by B. Statkevičienė, T. Venckūnas (pag. 233) in the study they conducted in 2008, as it follows: "The negative correlation between swimming technique score and the dimensions of body segments may mean that the large body parts hinder the development of swimming technique. With the increasing body dimensions, the water resistance while swimming also increases. "

Water balance is influenced by the homogenous resistance around the body, to which the hydro gravity action is added, requiring a noticeable mechanic input of the antagonist and agonist muscles with each movement.(Bădău Adela et al., (2014, pag. 12).

The study is in accordance with the previous statements of Badau A si colab. (2015, pg. 251) who consider that "The motric activity provides multiple new scientific discoveries in related fields which determine the optimization of human motric potential.directions for research with a strong social impact, it is in direct relation to the technological development"

## Conclusion

As a result of the development of this research the hypothesis was confirmed, namely by applying the methodology set out in the curricula for the first year students in physical education specialization, it can be obtained an improvement of the technical execution level in crawl stroke and facial gliding which can be influenced by anthropometric indices as well as by the hydrodynamic index.

The progress made by students is good but we believe this is mainly due to the applied methodology, to the means of action we selected and applied and to teaching coherent and logical strategies so as to cover all aspects of technical elements specific to crawl stroke and facial gliding. Precisely because of better techniques subjects made significant progress at both technical events/tests, which is not due to a general improvement of the swimming effort, is increasing the motric abilities such as speed and resistance but to the movements correctness. The arm wingspan, height and hydrodynamic index create the basis of an athletic structure which, through specialized training will lead to obtaining positive scores in swimming techniques.

We propose that the swimming subject at university should have a greater number of hours allocated in the near future so as we- teachers to be able to achieve some more refined aspects in our teaching and practice and to give enough time to future specialists to put into practice what they learned, to complete this course with full experience in their position of future teachers of physical education and sports field not only theoretical but also practical on different age and value ranges.

**Conflict of Interest**

The author has not declared any conflicts of interest.

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