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A survey on the adaptation to specific physical training using the investigation methods for competitive swimmers

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Abstract
Purpose. This paper comes into help for the coaches, showing some investigation methods which can be easily applied by them, in the absence of the physician or biochemist (which are not assisting the training usually), in order to achieve a high level of adaptation to the specific effort, the training state and effort capacity, and also technical and tactics improvement. **Methods.** We assumed, as hypothesis, that the investigation methods, science-based, used periodically during the trainings lead to a good effort adaptability and improvement of performance capacity of sportsmen, the training being done at optimal quotes. The study was conducted during 2016, November through 2017, May, in the CSM Bacau Club section of the city's Olympic Pool, on 8 teen subjects (male-3, female-5), with age – 15,5±1,85; the research methods were bibliographical study, testing, observational and statistics. Some investigation methods were chosen and described, together with the tests we considered fitted, our goal being a simple and concise reading of the results. **Results**. For the technical training subjects received the marks listed below (average ± standard deviation): at initial test (I) – 8,03±0,35, at the midlle test (M) – 8,53±0,22 and at the final test (F) – 9,10±0,21. At specific tests they gain the results: - time over 100m (T_{100}(s)): I – 70,56±9,73 and F – 69,62±9,70; - average speed (S_m(m/s)): I – 1,43±0,20 and F - 1,49±0,17; - specific resistance (R_s): I - 1,00±0,16 and F – 0,89±0,05. Also we observe that the progression coefficient calculated (Cp(%)) was improved with 10,61±8,99.

Conclusions. Our results, characterized by improved values, confirmed our hypothesis, proving that the tests and their correspondent samples can be used by the coaches, their influences and importance on the capacity effort being obvious.

Keywords: training, technical training, physical training, effort challenge, coefficient, tests.

Introduction

Considering the coaches' desire to practice a modern system of technical and physical training with their athletes, this paper tries to help them by presenting several varied investigation methods (Weineck, J., 1992) aimed at improving the swimmers' adaptation to the specific effort, their training, and their effort capacity, as well as perfecting their technical-tactical skills (Bota, C., 2000; Dragnea, A., 2002; Şalgău, S., 2007a).

The *main aim* of this paper was to identify the investigation methods that can be applied by the coaches themselves, considering that the physician or the biochemist is not always present during training.

Our *hypothesis* was: presumably, by using regularly investigation methods during training, the athletes' effort capacity will improve, the training being conducted scientifically, at optimal levels.

The research methodology

Location of the experiment

To verify the hypothesis, this study was conducted at the swimming section of CSM Bacău, and at the Bacau Olympic Pool.

Duration of the experiment

The experimental study started in November 2016, with collecting information, and ended in May 2017, when the conclusions were drawn.

Subjects

The experimental study was conducted on 8 subjects (3 males and 5 females), aged between 13 and 18. All subjects were professional swimmers.

Table 1. The subjects of thr study and technique prefered.

Nr.crt.	Name	Sex	Age	Technique
1.	B.I.	M	14	bras
2.	A.D.	M	16	butterfly;
3.	L.F.	M	18	crawl - speed;
4.	A.M.	F	15	crawl - speed;
5.	B.T.	F	16	bras;
6.	I.M.	F	18	crawl - resistance;
7.	M.P.	F	14	butterfly;
8.	B.M.	F	13	back

The Bacau Olympic Pool has a length of 50 m, and 8 lanes. Tools that were used: timer, frequency counter.

In this study, the following control challenges and tests were used: the technical training test, the physical training test, and the effort challenge (Maglischo, E.W., 1993a; Maglischo, E.W., 1993b; Şalgău, S., 2007b; Şalgău, S. & Acsinte A., 2007).

Results

The Technical Training Test

This test was applied during all three macrocycles, comprising initial, intermediary, and final assessments, being conducted in the middle of the training periods of each macrocycle. The assessment was made through grades (Table 2).

Table 2. Technical training results

No.	S.	Stroke			Body position			Legs			Arms			Coordination			Start			Return		
		I	**M**	**F**	**I**	**M**	**F**	**I**	**M**	**F**	**I**	**M**	**F**	**I**	**M**	**F**	**I**	**M**	**F**	**I**	**M**	**F**
1	B.I.	8	8	9	8	9	9	8	8	9	9	9	10	7	8	9	8	9	9	8	8	8
2	A.D.	8	8	9	9	9	10	7	8	9	9	9	9	8	9	9	9	9	9	7	8	9
3	L.F.	9	9	9	8	9	10	9	9	10	9	9	10	8	9	9	9	8	9	8	9	9
4	A.M.	8	9	9	8	9	10	8	8	9	9	9	9	8	8	9	8	9	9	8	8	9
5	B.T.	8	8	9	7	8	8	8	9	9	8	8	9	8	8	9	7	8	8	8	9	9
6	I.M.	9	9	9	8	9	9	8	8	9	8	8	9	9	9	10	9	10	10	8	9	9
7	M.P.	7	8	9	8	8	9	7	8	9	8	9	9	7	8	9	7	8	9	9	9	9
8	B.M.	8	9	9	7	8	9	8	8	9	8	8	9	7	8	9	8	9	10	8	9	9

Legend: S – subjects, I – initial, M – middle, F - final

To fully describe a subject, we have to make use objective data, some values for computed markers.

Table 3. Statistical parameters - test for technical training

No.	Subiect	Res. I	Res. M	Res. F
1	B.I.	8,00	8,42	9,00
2	A.D.	8,14	8,57	9,14
3	L.F.	8,57	8,85	9,42
4	A.M.	8,14	8,57	9,14
5	B.T.	7,71	8,28	8,71
6	I.M.	8,42	8,85	9,28
7	M.P.	7,57	8,28	9,00
8	B.M.	7,71	8,42	9,14
Average		***8,03***	***8,53***	***9,10***
Std. Dev.		***0,35***	***0,22***	***0,21***
Variab. Coeff.		***4,35***	***2,57***	***2,30***

Legend: I – initial, M – middle, F - final

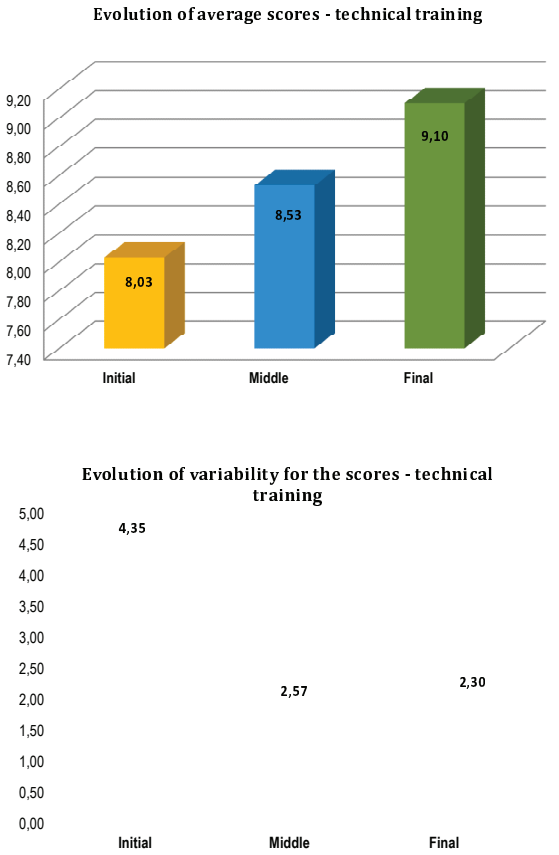

Fig. 1. Evolution of the average and variabilty coefficient of the scores, for technical preparing test.

The comparative analysis of the arithmetical means highlights an ascending line of the technical training level in all of the athletes who participated in this experiment, the recorded progress being between 0.8 and 1.5 points (Table 3). This proves that after the initial test, and after communicating the results to the coach, the action systems that were used resulted in perfecting the technique significantly, leading to the improvement of the swimmers' individual performances.

The Physical Training Test

The test was applied initially in the third week of the training macrocycle. The final test was applied during the pre-competition period.

The test consisted in measuring the times recorded over 10 m with a start, and 100 m swimming in the specialized stroke (Table 4).

For the purpose of bolding the progression, we introduce the progression coefficient:

$$Cp = (X_2-X_1)/X_2*100$$

where X_2 = time recorded in the initial test, X_1 = time recorded in the final test

The value of this coefficient is meant to show the achieved progress in percentages.

Table 4. Results for the physical training tests

No.	Subjects	T_{10}(s)		T_{100}(s)		S_a(m/s)		S_m(m/s)		R_s	
		I	F	I	F	I	F	I	F	I	F
1	B.I.	8,2	7,2	75	75	1,21	1,38	1,33	1,35	1,09	0,97
2	A.D.	8,8	6,2	66	65	1,13	1,61	1,51	1,51	1,33	0,93
3	L.F.	4,8	4,7	56,5	56,0	2,08	2,12	1,76	1,78	0,84	0,83
4	A.M.	5,7	5,2	59	58,0	1,75	1,92	1,69	1,72	0,96	0,89
5	B.T.	7,6	7,0	77	76	1,31	1,42	1,29	1,31	0,98	0,92
6	I.M.	6,2	6,0	86	85	1,61	1,66	1,16	1,44	0,91	0,86
7	M.P.	7,8	6,5	74	73	1,28	1,53	1,35	1,38	1,05	0,90
8	B.M.	6,0	5,7	71	69	1,66	1,75	1,40	1,44	0,84	0,82
Average		***6,88***	***6,06***	***70,56***	***69,62***	***1,50***	***1,67***	***1,43***	***1,49***	***1,00***	***0,89***
St. dev.		***1,40***	***,85***	***,73***	***9,70***	***0,32***	***0,25***	***0,20***	***0,17***	***0,16***	***0,05***

Legend: S = subject, Str. = stroke, T_{10} = time recorded over 10 m with a start (in seconds), T_{100} = time recorded over 100 m (in minutes and seconds), S_a = absolute speed over 10 m (in m/second), S_m = average speed over 100 m (in m/second), R_s = specific resistance, I – initial test, F – final test

Table 5 . The progression coefficient fot the timings achieved on initial and final tests on 10m distance with a start

No.	Subjects	Initial test X2(S)	Final test X1(S)	Progression coeff. (%)
1	B.I.	8,2	7,2	12,1
2	A.D.	8,8	6,2	29,5
3	L.F.	4,8	4,7	2,0
4	A.M.	5,7	5,2	8,7
5	B.T.	7,6	7,0	7,8
6	I.M.	6,2	6,0	3,2
7	M.P.	7,8	6,5	16,6
8	B.M.	6,0	5,7	5,0
	Average			***10,61***
	St. dev.			***8,99***

The comparative analysis of the initial and final test results shows an improvement in the times recorded over 10 m swimming with a start, and implicitly in the absolute speeds over this distance that represent a faster launch in the race.

The recorded progress values (Table 6), comprised between 2 and 29.5%, with an average of 10.6% prove that after communicating the results from the initial test to the coach, the training process was conducted more effectively, having as effect the recording of superior performances.

The large difference between the progression coefficients in athletes L.F. (2%) and A.D. (29.5%) can be explained by the fact that A.D. started from a much weaker result and improved it considerably, while L.F. started from a good result that was hard to improve further. The two values compared above represent the extremes, the arithmetical mean of the coefficients being in fact the significant one.

Calculation of the progression coefficient for the results recorded during competitions. The results were recorded during the competition periods corresponding to macrocycles 1, 2, and 3, as well as previously to the beginning of the experiment (Table 6). The analysis took into consideration the previous results and the ones recorded during the competition at the end of macrocycle 3.

Table 6. The progression coefficient for the results recorded during the competitions

Nr. Crt	Subjects	Prev. result X_2	Comp. res. macrocycle I	Comp. res. macrocycle II	Comp. res. macrocycle III	C.p. (%)
1	B.I.	1'15"	1'14"	1'12"	1'11"	5,3
2	A.D.	1'06"	1'06"	1'04"	1'01"	7,5
3	L.F.	56,5"	56"	55"	54"	4,4
4	A.M.	59"	58"	58"	57,6"	2,3
5	B.T.	1'17"	1'16"	1'14"	1'14"	3,8
6	I.M	9'30"	9'15"	9'15"	9'12"	3,1
7	M.P.	1'14"	1'12"	1'15"	1'09"	6,7
8	B.M.	1'11"	1'10"	1'09"	1'08"	4,2

After analyzing comparatively the results recorded before the experiment started and the ones recorded during the macrocycle 3 competition, one could see a significant improvement, by 4.6%. The progress can be followed by analyzing the results obtained during the competitions from macrocycles 1 and 3 (Table 7).

Even though three athletes stagnated, recording the same results in two consecutive macrocycles, considering their results previous to the experiment, their progress can be considered to be significant, the results being unquestionably improved.

Table 7. Analysis of the values for the specific resistance and its meanings

No.	Subjects	RS initial test	RS final test
1	B.I.	1,09	0,97
2	A.D.	1,33	0,93
3	L.F.	0,84	0,83
4	A.M.	0,96	0,89
5	B.T.	0,98	0,92
6	I.M.	0,91	0,86
7	M.P.	1,05	0,90
8	B.M.	0,84	0,82

In the initial test, one can see that the absolute speed is low, the specific resistance values being higher, a fact that was signaled to the coaches, who took the necessary steps, orienting the training in the proper direction.

The final test shows a reduced specific resistance, but still with values close to 1, which are considered to be very good (Galbo,

H., 1983). From this results the fact that absolute sped was not increased in the detriment of specific resistance, the consequence being better results during competitions.

The Effort Challenge

This challenge was used in the second macrocycle, during the training period, the mesocycle of basic resistance, assessing the effort adaptation level, effort capacity, and performance ability (Table 9).

The challenge consists in covering 8 × 50 m in the specialized stroke, with a 30″ break between repetitions.

Tabel 8. Effort challenge results

Nr. crt.	S	H.R. standing	H.R Warm-up	H.R. 4 × 50 m	H.R. 8 × 50 m	H.R. 30″	H.R. 1′ 30″	H.R. 2′ 30″	Avg.
1	B.I.	72	120	174	186	150	124	84	38
2	A.D.	78	126	186	192	162	130	90	33
3	L.F.	66	108	180	192	156	124	84	30
4	A.M.	72	120	180	194	162	130	90	31
5	B.T.	78	126	168	174	158	148	138	42
6	I.M.	60	102	176	186	144	108	72	31
7	M.P.	66	122	180	200	152	126	72	36
8	B.M.	72	126	168	180	152	128	78	36

Legend: *S = subject; H.R. = heart rate; Avg. = the results' average*

It is then evaluated using descriptors (Table 9).

Table 9. 8 x 50m technique, 30" break between repetitions

Nr. crt.	Subjects	Adaptation to effort	Training state	Effort capacity	Pulse elasticity
1	B.I.	very good	very good	very good	very good
2	A.D.	good	very good	good	very good
3	L.F.	very good	very good	good	very good
4	A.M.	good	good	good	good
5	B.T.	good	good	unsatisf.	unsatisf.
6	I.M.	very good	very good	very good	very good
7	M.P.	very good	very good	very good	very good
8	B.M.	very good	very good	very good	good

The analysis of the descriptors (Table 9) attributed to the athletes according to their heart rate values (Table 9) shows a good and very good level, with one exception, of the training state, effort ca-

pacity and pulse elasticity, which confirms also a high rate of post-efort recovery. The athlete B.T. represented an exception, recording an increased heart rate after 1'30" and 2'30". This fact was brought to the attention of the coach, who explained it as being probably a case of fatigue, his intention being to have further discussions with the athlete regarding her state of health and lifestyle, diet, and rest.

Discussions

The obvious progress shown by the recorded results allows the conclusion that the hypothesis has been confirmed.

The results recorded after the application of the effort challenge prove also that the training was judiciously planned, being conducted in an effective manner.

The case of the female athlete B.T., whose heart rate values after 8 x 50 m with a 30" break were too high, receiving the descriptor "unsatisfactory", was clarified, resulting, following ulterior discussions with the swimmer, that her resting regime was not followed, which led to these dysfunctions.

Conclusions

This experimental study tried to verify the hypothesis stating that the use of certain methods of investigation that are easy to use by the coach regularly, would improve the athletes' effort capacity, effort adaptation, training level, as well as their technical, physical, and tactical training level, all of them contributing to the improvement of the top performance capacity (Colwin, C.M., 2002). It started from the idea that the use of several applicable tests by the coaches themselves without the assistance of other specialists can offer the possibility of a real and objective assessment of the level reached by the athletes at one moment in time.

The investigation methods and tests considered to be the most appropriate were selected, the aim being for their interpretation to

be simple and conclusive at the same time. The methods of investigation that were used allowed the assessment of the athletes' weak and strong points, these bing communicated to the coach, who acted accordingly, directing the training process adequately.

The final results, characterized by improved values, prove that the tests and challenges presented in this paper can be used successfully by coaches, their influence and importance in regards to the effort capacity being evident.

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