INFLUENCE OF TECHNICAL ABILITIES OF SWIMMING ON THE RESULTING EFFICIENCY OF MIXED SWIMMING

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Abstract
The aim of this research is to determine the influence of swimming technical abilities (start, technique itself and turn), each of the mentioned swimming techniques (kraul, back, breast and dolphin) on the resulting efficiency of mixed swimming at 100 meters, as well as their interconnections. The study was conducted on a sample of 31 students, female, aged 20-24 years, with the help of testing (evaluation) of technical swimming skills (start, technique and turn): OCJKSTR, OCJKTEH, OCJKOKR, OCJLSTR, OCJLTEH, OCJLOKR , OCJPSTR, OCJPTEH, OCJPOKR, OCJDSTR, OCJDTEH, OCJDOKR) and mixed swimming at 100m (OCJPM100), in the following order: dolphin, back, breast, kraul. Analyzing the presented results of the regression analysis, it can be concluded that after the completion of testing (evaluation) of the whole predictor system, the following predictor variables had the statistically most significant influence on the OCJPM100 criterion variable: the score of kraul technique OCJKTEH (BETA) = 0,390, which is significant at the level of p = 0.008 , OCJPSTR (BETA) breast swimming start rating (BETA) = 0.417, significant at p = 0.014, and OCJPOKR (BETA) breaststroke rotation score = 0.234, significant at the level of p = 0.037. The correlation between PM100 and TEHKL has a negative value sign of r = - 0.5734. Connection ie. the correlation between PM100 and TEHLK has a negative value sign of r = - 0.2366. The correlation between PM100 and TEHPL has a negative value sign of r = - 0.3418. The correlation between PM100 and TEHDE is also a negative value sign of r = - 0.5002. The reason for this correlation is poor technical ability of the candidates to swim and breathe and they were not able to transfer their technical skills to the resultant efficiency at 100 m of mixed swimming.

Key words: *students, swimming techniques, mixed swimming, influence.*

Introduction

According to the structure of movement, swimming belongs to the category of cyclic sports in which the form and method of performance are dominated by relatively simple movements, which are constantly the same (Marković, 2017). Success in any sport activity, including swimming, depends on a large number of anthropological characteristics and abilities, as well as their interconnectedness.

Therefore, motor skills are very important for performing any of the swimming techniques (free swimming style) (Nikšić, et al., 2019). In order to be able to speak at all about the influence of the technical swimming skills (start, technique and turn), within each of the mentioned swimming techniques (kraul, back, breast and dolphin), on the resultant efficiency of mixed swimming at 100 meters, one must first know which is the level of their knowledge in performing these swimming techniques (Beganović, 2011). Competition analysis helps to show and analyze swimming parameters in the race. This kind of analysis is an ideal opportunity for error correction and suggesting how to rectify deficiencies in the coming period. It also contributes to a better quality setting of the competitive strategy. The competitive strategy, or as it is called tactical preparation for the performance, is developed and refined in the coaching process. During this process, coaches and swimmers have the opportunity to choose the most effective preparation for the competition. In a discipline of 100 meters free, the result significantly depends on the overall speed and time of clean swimming as well as the quality of turning and entering the goal (Marković, & Trivun, 2012). Based on the aforementioned, the aim of the research is to determine the influence of the technical swimming abilities (start, technique and turn), each of the above swimming techniques (kraul, back, breast and dolphin) on the resultting efficiency of mixed swimming at 100 meters.

Methods

The study included a population of students from the Faculty of Sport and Physical Education, University of Sarajevo (Bosnia and Herzegovina). The sample included a total of 31 female students, II year students, chronologically aged 20-24. It is important to note that the students voluntarily participated in the research. The research was conducted at the Faculty of Sports and Physical Education. Students were tested (rated) for their technical swimming skills (start, technique and turn), within each of the above swimming techniques (kraul, back, breast and dolphin). The variables used to evaluate the technical swimming ability are:

Kraul technique: evaluation of the start of kraul-OSK; evaluation of the kraul-OTK technique; grade turn kraul-OOK.
Back kraul technique: start score back kraul-OSLK; evaluation of the back kraul-OTLK technique; grade turn back kraul-OOLK.
Chest Technique: Chest Start OSP; evaluation of the thoracic-OTP technique; chest-OOP turn rating.
Dolphin Technique: Dolphin-OSD Start Rating; evaluation of the dolphin-OTD technique; turn rating of dolphin-OOD.

All data collected through the survey were processed using descriptive and comparative statistics. From the area of descriptive statistics, measures of central tendency and measures of dispersion were calculated for each variable: arithmetic mean (Mean) and standard deviation (Std. Dev.). From the space of comparative statistics, a causal parametric regression analysis procedure was used. The statistical program for personal computers SPSS for Windows version 20.0 was applied for data processing.

Results

Figure 1 shows the numerical quantitative parameters of the ratings of each individual swimming technique. The highest average score was observed in the dorsal kraul technique (6.63), followed by the breast technique (6.59) and the kraul technique (6.48), while the lowest grade was recorded in the dolphin technique (6.45). Graph 2 shows the average swimming time of 100 meters in mixed style, with the best result (110 sec) and the worst result (226 sec).

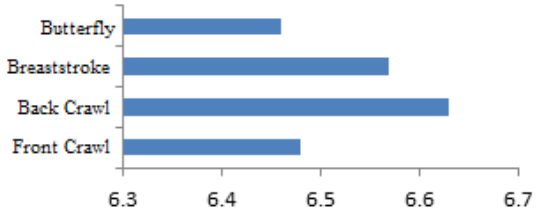

Figure 1. Average values of the swimming technique ratings

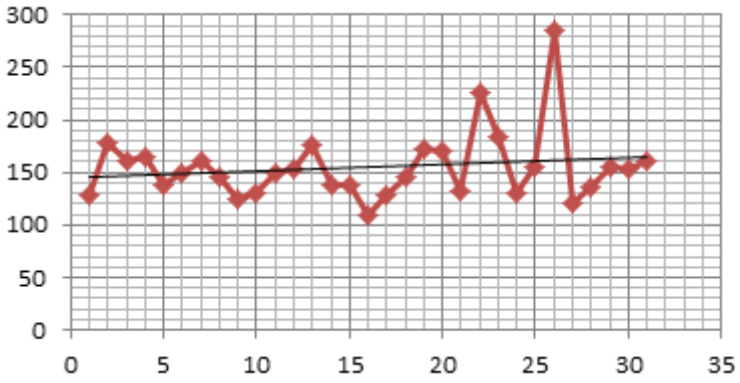

Figure 2**.** Average swimming values per 100m in mixed style

In (Table 1) the values of the multiple correlation coefficient between the predictor variables and the criterion variable are shown, while in (Table 2) the values of the F ratio level are shown in examining differences between the subgroups of results along the regression direction. Based on the magnitude of the multiple regression (R), the joint variance (R Squere) is explained only if it is statistically significant.

Table 1. Multiple correlation coefficient.

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	**.970[a]**	**.940**	.901	.15605
a. Predictors: (Constant), OSK, OTK, OOK, OSLK, OTLK, OOLK, OSP, OTP, OOP, OSD, OTD, OOS				

A rather high coefficient of multiple correlation R = 0.970 indicates a statistically significant influence of all predictor variables on the criterion, which means that the success of mixed swimming at 100 meters can be predicted throughout the predictor system. The following predictor variables had the greatest and statistically significant effect on the OP100m criterion variable: OOK p <.008; OTP p <.014; OSD p <.037, Table 3.

Table 2. Significance level of F ratio.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.916	12	.576	23.668	.000[a]
	Residual	.438	18	.024		
	Total	7.355	30			
a. Predictors: (Constant), OSK, OTK, OOK, OSLK, OTLK, OOLK, OSP, OTP, OOP, OSD, OTD, OOS						
b. Dependent Variable: OPM100						

Table 3. Values and significance level of standardized and non-standardized regression coefficients for individual predictor variables.

Variables			Beta	t	Sig.
	B	Std. Error			
OOK	.397	.132	.390	3.010	.008
OTP	.363	.133	.417	2.731	.014
OSD	.204	.091	.234	2.250	.037

Table 4 shows the average scores for all subjects, as well as the average score for individual techniques and swimming time in 100 meters in mixed style.

Table 4. Average rating for individual swimming techniques and swimming time at 100m.

N	Kraul			Back			Breast			Dolphin			PM100
	Mean±Std.Dev.			Mean±Std.Dev.			Mean±Std.Dev.			Mean±Std.Dev.			Mean±Std. Dev.
	Start	Technique	Turn	Start	Technique	Turn	Start	Technique	Turn	Start	Technique	Turn	
31	6.54±.52	6.44±.43	6.47±.61	6.7±.41	6.67±.40	6.51±.53	6.58±.48	6.6±.43	6.52±.45	6.53±.45	6.36±.53	6.5±.45	154.72±33.21

Table 5 gives an overview of the correlations between the technical swimming abilities with the resulting efficiency at 100 m mixed swimming in FASTO students. The correlation between PM100 and TEHKL has a negative value sign of r = - 0.5734. Connection ie. the correlation between PM100 and TEHLK has a negative value sign of r = - 0.2366. The correlation between PM100 and TEHPL has a negative value sign of r = - 0.3418. The correlation between PM100 and TEHDE is also a negative value sign of r = - 0.5002.

Table 5. Correlation of technical swimming abilities with resulting efficiency in 100m mixed swimming.

Variables	TEHKL	TEHLK	TEHPL	TEHDE	PM100
TEHKL	1,0000	0,5512	0,7349	0,5964	-0,5734
TEHLK	0,5512	1,0000	0,7252	0,5068	-0,2366
TEHPL	0,7349	0,7252	1,0000	0,4318	-0,3418
TEHDE	0,5964	0,5068	0,4318	1,0000	-0,5002
PM100	-0,5734	-0,2366	-0,3418	-0,5002	1,0000

Discussion

Trivun et al. (2015), conducted a study on male and female University of East Sarajevo Faculty of Physical Education and Sports students who passed the entrance exam (as an initial measurement) and later enrolled in the second year of study and the same section (as a final measurement) . The research period covered two generations of the academic year 2010/2011 and 2012 / .2013. The aim of the study was to determine how much exercise and other extracurricular activities influenced the change in swimming performance freely at 50 meters during study in the first year. Based on the analysis of the collected data, qualification exams in the school years (2010/2011 as well as 2012/2013) at the initial measurement and the same respondents (at the final measurement) in the second year of study on the study program: physical education measures of the central tendency of descriptive statistics were obtained . Analyzing the t-test on small dependent samples of subjects gives a difference in the results at the initial and final measurements. The statistical difference has a slight level of significance between the initial and final measurement of subjects at 50 meters free swimming. With regard to the qualification (entrance) exam and the initial measurement of the male population in the second year of the exercise foreseen in other previous subjects, as well as the activities of the students outside of class did not have a statistically significant effect on the resultant performance in swimming at 50 meters free swimming.

After analyzing the descriptive statistics of the initial and final measurements of free-swimming (kraul), at 50 meters in the male population, of the

2010/2011 school year, the following results were obtained at initial measurement: minimum (35.13), maximum (74.61), mean (Mean = 49.59), and standard deviation (8.49), while the same population at final measurement had: minimum (34.37), maximum (73.63), mean (Mean = 49.43), and standard deviation (8.44). After analyzing the generation of the 2012/2013 school year, the following results were obtained at initial measurement: minimum (36.38), maximum (81.63), mean (Mean = 54.03), and standard deviation (9.79), while the same population at final measurement had: minimum (36.43), maximum (81.36), mean (Mean = 53.05), and standard deviation (9.89). After analyzing the descriptive statistics of the initial and final measurements of the 50m breaststroke in the female population, generation 2010/2011, the following results were obtained at initial measurement: minimum (63.75), maximum (80.86), mean (Mean = 75.50), and standard deviation (6.58), while the same population at final measurement had: minimum (62.99), maximum (80.61), mean (Mean = 74.93), and standard deviation (6.54), (Trivun et al., 2015).

Kazazović (2008), in the work of the test of swimming ability to assess swimming speed at 50 meters, or 100 m, the swimmer determines which technique to swim. This part of the swimming ability can be tested in the pool or at improvised swimming areas. It is advisable, when possible, to perform the test in the pool, as the length is specified, and it is possible to start swimming with a head jump from the starting blocks. However, when the test is carried out at an improvised swimming area, the length of the swimming area should also be clearly and visibly marked and, where possible, the conditions for the start of the swim should be provided by a jump start. In the work of the test of swimming ability, which refers to the assessment of the length and duration of swimming (at 200, 300, 400, 500, 600, 800 meters), the speed and technique with which to swim also determines the swimmer.

Trivun, Grahovac (2011), on the sample of 43 students of the school population 2009/10 of the Faculty of Physical Education and Sports of the University of East Sarajevo, enrolled in the third year of study, male chronologically aged 23 years ± 6 months, the results were compared in the following parameters : variable frequency of the stroke on one side and swimming in natural conditions at 120m. The variables that made the stroke frequency during freestyle swimming (the kraul technique) showed its effective value on the result of the swimmed section by the kraul technique at Tjentište during activities in the nature, with high oscillation as provided by mountainous, natural environments. The value obtained by the multivariate regression result, with the F-test is 4.49 at the significance level p = 0.04 in this paper gives the information on the efficiency of the stroke on the resulting success in swimming with the 120-meter kraul technique.. The multiple regression results that were interpreted relating to the frequency of the strokes on the resulting performance of the kraul technique in natural conditions were (P =, 31), thus explaining .098% (P2 =, 098) of the common information between the mentioned variables. Analyzing the individual contribution of the variables of the stroke frequency (t) to the resulting performance in swimming gives a modest contribution, which concludes that the rest belongs as for example: to the optimum number of strokes, leg work, swimming step and other factors, which were not the subject of this study. They conclude that forcing high frequency of strokes leads to a dynamic stereotype, that is, panic movement, when movements, though powerful and fast, become less effective. Swimming at the same pace also leads to dynamic stereotype, so it is recommended during the training process to swim with different stroke frequencies, but always with a feeling of water. Dynamic stereotyping can occur when swimming at submaximal or maximum speeds during training and refinement of the technique.

Trivun et al. (2018), on a sample of 36 subjects divided into three sub-samples of 12 swimmers participating in the Bosnia and Herzegovina Open Championships in 2018 and 2017, as well as rallies at the 25th „Ante Lambaša" International Memorial in Belgrade in 2017, took data from the minutes of swimming competitions of passing times, as well as the final results of swimming freely at 400 meters. The study was conducted with the aim of determining the influence of swimming sections (50, 100, 150, 200, 250, 300 and 350) meters as a predictor set of variables and influence on the criterion variable of the resulting swimming performance 400 m freely. The results of the regression analysis indicate a statistically significant association of a set of variables (50, 100, 150, 200, 250, 300, and 350) with the criterion variable of swimming 400 freely.

The value of the multiple correlation coefficients determining the influence of the setat predictor variables (50, 100, 150, 200, 250, 300 and 350) on the criterion variable 400 m of swimming freely is: for 50 m 42%, 100 m 52%, 150 m 65%. 200 m 67%, 250 m 67%, 300 m 68%, 350 m 43% of the total variance of swimmers of the Olymp Banja Luka Rally in 2018. The value of the multiple correlation coefficients determining the influence of the sets of predictor variables (50, 100, 150, 200, 250, 300 and 350) on the criterion variable 400 m of swimming freely is: for 50 m 58%, 100 m 59%, 150 m 71%. 200 m 70%, 250 m 71%, 300 m 70%, 350 m 41% of the total variance of the swimmers of the Olimp Banja Luka Rally in 2017. The value of multiple correlation coefficients determining the influence of the sets of predictor variables on the criterion variable 400 m of swimming freely is: 50 m 58%, 100 m 65%, 150 m 62%, 200 m 84%, 250 m 67%, 300 m 89%. 350 m 76% of the total variance of swimmers of the 2017 "Memorijal Ante Lambaša" rally in Belgrade. The authors concluded that the predictor variables (50, 100, 150, 200,

250, 300 and 350) of swimming freely have a significant percent of the influence on the criterion variable 400 m freely by rally swimmers at the 25th „Ante Lambaša" International Memorial in Belgrade 2017 Serbia compared to the same in swimmers participating in the Open Championships of Bosnia and Herzegovina in 2018 and 2017, respectively.

Conclusion

Regression analysis was applied to determine the influence of the technical swimming abilities (start, technique and turn), within each of the mentioned swimming techniques (kraul, back, breast and dolphin), on the resulting efficiency of mixed swimming at 100 meters in FASTO students. For the study to be successful with respect to the problem, the ratings for the following sample variables were used: kraul start score - OCJKSTR, kraul technique score - OCJKTEH, kraul turn score - OCJKOKR, back kraul start score - OCJLSTR, back kraul technique score - OCJLTEH, back kraul turn score - OCJLOKR, chest swim start score - OCJPSTR, breast swim technique score - OCJPTEH, chest swimming turn score - OCJPOKR, dolphin start score - OCJDSTR, dolphin technique score - OCJDTEH, Dolphin Turn score - OCJDTEH turn score and mixed swimming at 100m (OCJPM100m), in the following order: dolphin, back, breast, kraul. Based on the presented results of the regression analysis, it can be established that a rather high coefficient of multiple correlation R is present, which indicates a statistically significant influence of all predictor variables on the criterion, which means that the success of performing mixed swimming at 100m can be predicted throughout the entire predictor system. The individual correlation of mixed swimming at 100m with each individual swimming technique has a negative sign. The correlation between PM100 and TEHKL has a negative value sign of r = - 0.5734. Connection ie. the correlation between PM100 and TEHLK has a negative value sign of r = - 0.2366. The correlation between PM100 and TEHPL has a negative value sign of r = - 0.3418. The correlation between PM100 and TEHDE is also a negative value sign of r = - 0.5002.

The reason for this correlation is candidtes' poor technical ability to swim and breathe and they were not able to transfer their technical skills to the resulting efficiency at 100 m mixed swimming. Performing mixed swimming at 100 m should be performed at a moderate pace, but so that at each attempt to swim the first 15 m is swimming at an accelerated pace, or move at a moderate intensity and then increase up to 70-80%, which means that again we go to the submaximal load.

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