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The Effect of Immediate Verbal Feedback on the Efficiency and the Effectiveness of Swimming

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Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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Introduction

A motor learning process is associated with information processing during and after performing a motor activity [1]. This approach is based on a thesis that people receive and process information available in the environment in order to perform certain motor activities. Conditions in which a person performs a particular motor activity and quality of information reaching him or her have a significant influence on the motor learning process and its final execution [2]. Help for people learning motor activities can be provided by extrinsic feedback (augmented feedback) and obtained visually, aurally or in a tactile way [3].

The term "feedback" refers to information about motor activity consequences derived from the sense organs of its performer [2] but it is also a process in which information enters the information processing system in order to control motor activity [2]. According to Bernstein, the essence of control lies in a constant assessment of the desired value with the current value of motor activity parameters [4]. This duality leads to defining the research subject. In this work the term "feedback" will be used in its first meaning, as information about motor activity which is its result.

All the information that reaches a person through senses can be divided into information associated and not associated with movement. The first one can be divided into those initiated by movement (feedforward) and those available due to the executed movement (feedback) [2].

Taking into account the criteria of feedback origin, we can distinguish intrinsic feedback and extrinsic feedback. Intrinsic feedback also known as inherent feedback is sensory information created as a result of performing a movement [1]. The source of intrinsic feedback can be located outside the body (exteroception) or inside the body (proprioception). Extrinsic feedback also called augmented feedback occurs after completion of motor activity and it is provided by another person. Motor control is carried out by e.g. teacher's verbal instruction, timer indications or a video with a record of specific motor activity [1]. In contemporary motor learning there must be feedback that involves sending information from a learner to the teacher, who can assess his educational actions only in this way [5]. Feedback is a help in gaining information about motor activity which a person cannot collect by himself or herself [6].

There are two kinds of extrinsic feedback: knowledge of performance and knowledge of results [1]. Examples of providing feedback are: video recording, visual feedback, verbal feedback [7, 8, 9]. From information about the result, a person can seek for knowledge about how his or her aim was accomplished [1]. Also, depending on a transmission channel there are verbal feedback and non-verbal feedback [10].

Extrinsic feedback plays important functions in the motor teaching and learning process [2]. First of all, it provides the learner with information about the performed motor activity; this is an informative function. Secondly, it motivates or activates people through performing motor activity; this is a motivation function. Thirdly, it has a strengthening function, which inclines to repeat motor activity correctly, and a punishing function, which prevents actions incompatible with the motor activity model.

The time of providing feedback is a different issue. Feedback can be provided immediately after the performed motor activity, and in this situation it is called immediate feedback, or it can be provided with a delay, and therefore it is called delayed feedback [1]. There are also concurrent feedback provided while activity is being carried out and terminal feedback provided right after a movement stops [2].

In the aquatic environment sources of information are sight, hearing (exteroception) and profound sense (proprioception); however, intrinsic feedback does not provide essential information all the time to perform motor activity effectively. Additionally, conditions at the pool impede information exchange between a teacher and a learner due to distorting factors such as distance between the teacher and the learner or prevailing noise. In the past attempts to overcome communication limitations were made by separating sources of immediate feedback [11]. The first group contained sound (teacher's short exclamations, hand claps). The second group consisted of visual sources. Gestures significantly simplify communication between a teacher and a learner without overusing voice and stopping the learner. However, it has to be in mind that not in every swimming technique eye contact between a teacher and a learner allows gestures to be used. This type of information transfer is mostly used in teaching back crawl technique due to the head positioned on the water surface, which means a limited use of gestures. The third group included tactile sources (a swimming pole) that affect the learner's sensory receptors [11].

Extrinsic feedback is treated as help for swimmers, where feedback on the swimming tempo was provided to them by a submerged timer at the bottom of the swimming pool and also by stroboscope lights used for mastering backstroke technique or strength value reached on a swimming ergometer [12, 13, 14].

Research Subject

The research subject was to define the influence of immediate verbal feedback (IVF) on swimming efficiency and effectiveness. Swimming efficiency was expressed by swim cycle characteristics. The kinematic parameter of swim cycle length was used as a diagnostic value. Swimming effectiveness was defined as the time of accomplishing the distance that was also a diagnostic value.

Effectiveness is defined as work performed against expended energy of this work [15]. Swimming effectiveness was a relation between mechanical energy expanded in order to overcome inhibitory resistance associated with body movement in water (P_d) and the total processed mechanical energy expanded due to body movement in water with help from propulsive movements (P_o) [16]; it was expressed by the equation:

$$e_p = \frac{P_d}{P_o} = \frac{P_d}{P_d + P_k}$$

where:
P_o – total energy, P_d – energy expended to overcome resistance energy, P_k – energy lost in water whilst changing into kinetic energy.

It is assumed that the length of a swim cycle and movement frequency reflect work performed to overcome water resistance by a swimmer and the total processed mechanical energy due to propulsive movements carried out by limbs in order to obtain the maximal swimming speed [17]. The length of a swim cycle and movement frequency also determine coordination mechanisms of the described relation to obtain the maximal swimming speed [17]. Therefore, a swim cycle length was assumed as an objective measure of swimming efficiency.

Effectiveness is an action leading to the intended goal [18]. Swimming effectiveness was an action leading to minimizing the time of accomplishing the distance. Therefore, the time of accomplishing the distance was a measure of swimming effectiveness.

Research Purpose

The research purpose was to establish the difference between a swim cycle length and the time of accomplishing 25 m (in a control and an experimental group) as a result of providing immediate verbal feedback (an independent variable). An additional purpose was to design and verify the accuracy of the device providing wireless verbal communication between a teacher and a swimmer at the time of swimming as assistance in motor teaching and learning.

Hypothesis

It was assumed that there is a relation between immediate verbal feedback and a swim cycle length and the time of accomplishing the distance of 25 m front crawl.

Research Questions

The following research questions have been established:

1. How does a swim cycle length change under the influence of provided immediate verbal feedback?
2. How does the time of accomplishing the distance of 25 m change under the influence of provided immediate verbal feedback?

Material and Methods

Selection for the Research

Ten men who train swimming were tested. They were characterized by the following parameters: age ($\bar{x}$=22.3 ± 2.5 years old), height ($\bar{x}$=178.7 ± 9.4 cm), body mass ($\bar{x}$=70.8 ± 11.4 kg), arm span ($\bar{x}$=183.3 ± 9.0 cm). The subjects' average personal best for 50 m freestyle was ($\bar{x}$=27.2 ± 1.6 s). They were divided and allocated into two groups based on a random choice: the control group (n=5) and the experimental (n=5). Before conducting the tests a consent of the ethical committee was granted to use the suggested methods. A written consent was received from subjects to participate in the experiment; however, they were not informed about the purpose of the experiment. Data presenting research participants' characteristics reflect the idea of choosing research subjects who correspond to the research aims. The subjects were chosen with respect to the following criteria: i) age, ii) technique level that was measured with the personal best time for 25 m freestyle, iii) somatic parameters that were objective reasons for similar subjects' potential to generate propulsion (based on kinematic stroke parameters such as a stroke length and a stroke rate), which affects the efficiency and effectiveness of swimming. The similarity of somatic parameters has created a belief of the subjects' comparable motor potential. To make groups more equal in terms of the sports level, we assumed that the standard deviation cannot be higher than 10% of the average value of the personal best times ($\bar{x}$ =27.2 ± 1.6 s and 10% $\bar{x}$ =2.72).

Research Methods

The laboratory experiment method was used in the research, and it was based on dividing the subjects into two groups (the control group and the experimental group) and implementing an experimental factor (an independent variable) for the experimental group. Tests performed by subjects were conducted by one experimenter.

Research Procedures

Research was performed on a short-course indoor swimming pool. The analysis was performed in the Laboratory of movement analysis in the aquatic environment that holds the Quality Management Certificate No PN-EN ISO 9001:2009 (PW-48 606-10 D). Since a swim cycle length is an individual parameter [19], each subject performed the tests with the maximal speed. To establish the maximal speed, it was assumed that the average time of accomplishing the distance in the first and the second tests could not be better than 10% of the average time of accomplishing the distance in the third and the fourth tests, and this was expressed by the following equation:

$$t_{3,4/1,2} = 100 - \frac{t_{3,4}}{t_{1,2}} \times 100 \qquad (1)$$

Research consisted of four attempts using the front crawl technique starting from still lying down position. The first and the second attempts for the control group were based on swimming 25 m freestyle with the maximal speed without immediate verbal feedback support aimed at improving the swim cycle length. The third and the fourth attempts for the experimental group were based on swimming 25 m freestyle with the maximal speed and with immediate verbal feedback support aimed at improving the swim cycle length (independent variable – cause). In the control group during these trials immediate verbal feedback was not provided. In order to minimize causes of fatigue, subjects performed all trials with resting heart rate. The resting heart rate was established before trials in the 5th minute of a 10-minute warm-up.

All trials were recorded by two cameras with 50 Hz frequency. The first camera (C1) (Sony DCR-TRV 22E) was located in the middle of the pool in a waterproof case at the depth of 1 m perpendicular to the swimmer's movement, at a distance of 3 m from the swimming axis. This camera positioning allowed registering as much of the swimmer's figure as possible, while maintaining the possibility to register at least one complete swim cycle. The second camera (C2) (Sony DCR-TRV 8E) was located on the edge of the pool still and perpendicular to the swimmer's movement. This camera positioning allowed registering motor cycles in the analyzed section of 15 m including the so-called "pure swimming area". In order to calibrate the measuring system, a calibration frame was used with dimensions of 2 m by 2 m. It was located vertically in the swimmer's movement axis. On the swimmers' head and on the line of the radial-carpal joint of both hands contrasting markers were placed [20]. Every attempt took place in water, where standardized environment conditions prevailed (temperature 27°C). Fig. 1 presents the measuring track.

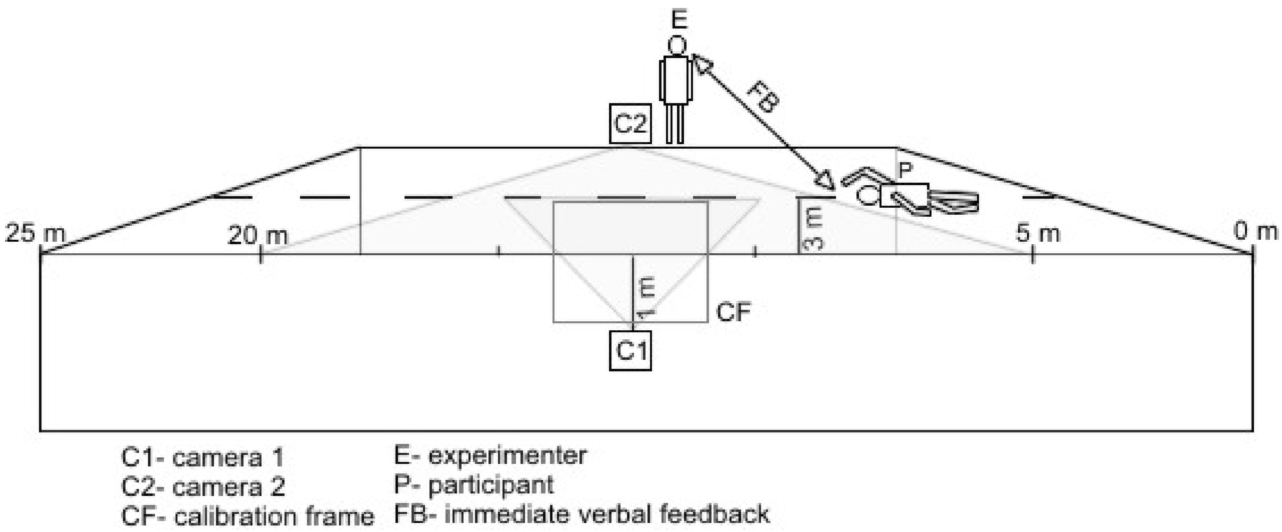


Fig. 1. Measuring track scheme

Procedure of Preparing an Independent Variable for the Experimental Group

In the research the independent variable consisted of extrinsic feedback aimed at increasing the swim cycle length, and it was categorized as [1]:

a) verbal, because it is provided by the experimenter by using words [10],

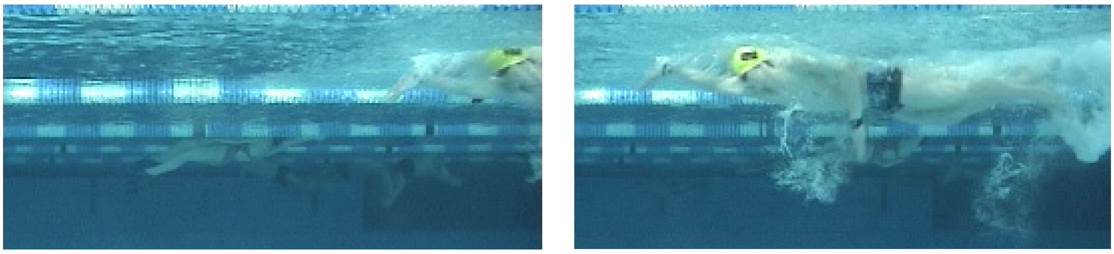
b) immediate, due to its immediate delivery at a time of swimming [1],

c) simultaneous, because it is delivered while the swimmer is in continuous movement [2].

Since people who participate in a teaching and learning process have limited perception of extrinsic feedback [21], the structure of verbal information of extrinsic feedback was optimized. In verbal information optimization effective didactical communication criteria (syntactic, semantic, pragmatic) were used [22] as well as the rule of maximum information – minimum words [1]. As a result, verbal information: "reach further with your hand" was created, and further on it is called verbal feedback. It was provided at a time of the third and the fourth trial for the experimental group. To prevent redundancy of verbal feedback, for "Reach further with your hand" a synonym was created – "put your hand further". Both of these synonyms were expressed by the experimenter at the time of trials.

Procedures of Measuring Independent Variables

Swim cycle length: The swim cycle length was a measure of distance of the body movement of one swim cycle expressed in meters [23]. The swim cycle length was established (Fig. 2) on the basis of the horizontal shift of a marker located on the swimmer's head starting from the "catch" phase of the movement (A) and ending when hand after performing a full propulsive stroke and recovery returned to the previously described position (B) [24]. Sensomotoric sequence is an elementary configuration of motor activity restricted by decision spots where there is no other decision in between the sensomotoric system structure [25].



A **B**

Fig. 2. An example of the swimming cycle measurement procedure from the first sequence of the A phase to the last sequence of the B phase [24]

The specification of the stroke length was carried out by two methods and was based on an analysis of the video footage. During recording and analysing the swimming cycle parameters, the ISO 9001:2009 standards were complied with and the conditions of the software manufacturer SIMI Reality Motion Systems 2D were fulfilled.

The first method used the motion analysis software (SIMI Reality Motion Systems 2D). In this method the swimming cycle was analysed in the so-called "clean swim zone" at a distance of 15 meters, excluding the start and finish zones.

The second method based on the equation specifying the average length of a swimming stroke (2) [26]:

$$l\,[m/cycle] = \frac{d\,[m]}{c} \qquad (2)$$

where *d* – distance, c – number of the motor cycles.

This method analysed the motor cycles in the so-called "clean swim zone" at a distance of 15 meters, excluding the start and finish zones.

A motor cycle is a full range action of the limbs [26]. The definition of the number of motor cycles was based on the video footage from a video camera (C2).

Time: For the needs of the time measurement an automatic system was used – the Colorado Time System – consisting of a tensometric start platform, touch panel and a clock which measured the time with an accuracy of 0.001s.

Research tool: Especially for the needs of this study a waterproof communication set was developed. It allowed the transfer of information between the researcher and the tested person. It consisted of a waterproof band Amphibx Large, waterproof earphones Surge Pro, a swimming belt Amphibx (H_2O audio) and a transmitter and a receiver, that is two handheld transceivers Maxcom WT-108 and a Alphard Mini Headset HS-02 microphone (Fig. 3a and 3b). The installation process of the device was based on buckling the whole set around the waist of the tested person and plugging the earphones into ears. A person transmitting immediate verbal information feedback was equipped with the transmitter and a microphone. Sound was transmitted by radio waves, the connection was wireless, which allowed communication between the two persons.

Fig. 3. a) The researcher transmitting verbal information with an installed transmitter. b) The tested person with an installed communication receiver

Statistical analysis was executed in Statistica 9.0 (Statsoft) program with the statistical significance level Alpha=0.05. The denomination differences were affirmed by comparing the data obtained from the research groups. In order to verify whether the values of the samples obtained from the independent populations were equal, the U Mann-Whitney's nonparametric significance test was used [27]. This test was used in order to check the statistically significant differences between small groups, more specifically: the stroke length and the time required to cover the distance of 25 meters, assuming that a dependent variable is different from the normal (Gaussian) distribution.

Data was obtained on the basis of developed formulas (3 – 10):

The average time for covering the distance in tests 1 and 2 were defined by the following equation:

$$t_{1,2} = \frac{t_1 + t_2}{2} \quad (3)$$

Analogously, for tests 3 and 4, the average time for covering the distance was defined by the following equation:

$$t_{3,4} = \frac{t_3 + t_4}{2} \quad (4)$$

The percentage of the average time to cover the distance in tests 3 and 4 in reference to the average time to cover the distance in tests 1 and 2 was described by the equation:

$$t_{3,4/1,2} = 100 - \frac{t_{3,4}}{t_{1,2}} \times 100 \quad (5)$$

The average stroke length in tests 1 and 2 was described by the equation:

$$l_{1,2} = \frac{l_1 + l_2}{2} \quad (6)$$

Analogously for tests 3 and 4 the average stroke length was described by the equation:

$$l_{3,4} = \frac{l_3 + l_4}{2} \quad (7)$$

The percentage of the average length of a swimming cycle in tests 3 and 4 in reference to the average length of a swimming cycle in tests 1 and 2 was described by the equation:

$$l_{3,4/1,2} = \left(\frac{l_{3,4}}{l_{1,2}} - 1 \right) \times 100 \quad (8)$$

The time differences for covering the distance in tests 1, 2 and 3, 4 were described by the equation:

$$\Delta t = t_{1,2} - t_{3,4} \quad (9)$$

The differences of the stroke length in tests 1, 2 and 3, 4 were described by the equation:

$$\Delta l = l_{1,2} - l_{3,4} \quad (10)$$

Results

Results prove that in the experimental group in tests with the immediately delivered verbal information feedback (independent variable) oriented towards elongation of the stroke length there was a 0.04 m increase in the stroke length, which is a growth of 2.63% in comparison to the average length of a swimming cycle from the two previous tests, in which immediate verbal feedback information was not delivered. Furthermore, there was a 0.69 s decrease in the average time needed to travel a 25 m distance, which is a 4.34% decrease in comparison to the average time from the two previous tests, in which immediate verbal feedback information was not delivered. In the control group, in which immediate verbal feedback information was not delivered, there was a 0.03 m reduction in the average length of a swimming cycle, which is a 1.38% decrease in comparison to the average length of a swimming cycle in the two previous tests. It was observed that the average time needed to cover the distance of 25 m fell by 0.26 s which is a 1.63% reduction in comparison to the average time needed to cover the distance from the two previous tests (see Table 3). The stroke rate among four subjects from the experimental group remained the same during all of the four tests, while in one person an increase in the stroke rate was observed (see Table 1). The average length of a swimming cycle – calculated using the second method (2) – was a confirmation of the data collected by the first method, which used motion analysis program Simi Motion 2D. Due to a small research group we cannot assume that the experimental group is statistically different from the control group in the analyzed variables, according to U Mann-Whitney's test (Table 3) However, there is a tendency where we can expect that statistical importance will rise when the size of the research group increases (the small number of research respondents was a result of a pilot character of the study). In the subsequent twin studies (with the number of research respondents up to 64 people) using the method of immediate verbal feedback (IVF) [28], statistical importance was observed, which confirms the validity of the assumed theses.

Tab. 1. Values of time needed to travel a distance (t), stroke length (l) and stroke rate $(\bar{x}\ nc)$ in all tests in both experimental and control group

Group	Subjects	t_1 [s]	l_1 [m]	t_2 [s]	l_2 [m]	t_3 [s]	l_3 [m]	t_4 [s]	l_4 [m]	$\bar{x}\ l_{12\,m2}$ [m]	$\bar{x}\ l_{34\,m2}$ [m]	$\bar{x}\ nc_{12}$	$\bar{x}\ nc_{34}$
Experimental	X1	15.41	1.79	15.55	1.78	15.50	1.90	15.21	1.89	1.76	1.76	8.5	8.5
	X2	14.72	2.10	14.70	2.05	13.94	1.90	14.41	2.01	2.14	2.00	7	7.5
	X3	14.47	2.01	14.47	2.01	14.06	1.98	13.79	2.22	2.00	2.00	7.5	7.5
	X4	16.56	1.84	15.87	1.84	15.50	1.86	15.47	1.89	2.00	2.00	7.5	7.5
	X5	16.22	1.60	17.28	1.69	15.09	1.60	15.40	1.90	1.82	1.76	8.5	8.5
Control	Y1	14.78	1.54	14.72	1.59	15.54	1.66	14.78	1.69	1.72	1.82	8.7	8.2
	Y2	18.00	1.48	18.57	1.56	18.37	1.45	18.34	1.51	1.42	1.42	1.0.5	1.0.5
	Y3	14.91	2.24	15.03	2.30	14.95	2.26	15.10	2.15	2.30	2.30	6.5	6.5
	Y4	16.65	1.93	16.00	2.11	15.80	1.99	15.56	1.94	1.87	1.87	8	8
	Y5	15.19	2.05	15.19	2.15	13.91	1.99	14.12	1.97	2.08	2.00	7.2	7.5

$\bar{x}\ l_{12\,m2}$, $\bar{x}\ l_{34\,m2}$ – average stroke length in tests 1, 2 and 3, 4 calculated using the second method (2)
$\bar{x}\ nc_{12}$, $\bar{x}\ nc_{34}$ –average stroke rate in tests 1, 2 and 3, 4

Table 2 contains the analysis calculated using equations 3 – 10 (see above).

Tab. 2. Values of the average time needed to travel a distance, the stroke length and differences in tests 1, 2 and 3, 4 for both the experimental and the control group

Group	Subjects	t_{12} [s]	t_{34} [s]	Δt [s]	$t_{34/12}$ [%]	l_{12} [m]	l_{34} [m]	Δl [m]	$l_{34/12}$ [%]
Experimental	X1	15.48	15.36	.0.13	0.81	1.79	1.90	-0.11	6.16
	X2	14.71	14.18	0.54	3.64	2.08	1.96	0.12	-5.78
	X3	14.47	13.93	0.55	3.77	2.01	2.10	-0.09	4.48
	X4	16.22	15.49	0.73	4.50	1.84	1.88	-0.03	1.90
	X5	16.75	15.25	1.51	8.99	1.65	1.75	-0.11	6.38
Control	Y1	14.75	15.16	-0.41	-2.78	1.57	1.68	-0.11	7.03
	Y2	18.29	18.36	-0.07	-0.38	1.52	1.48	0.04	-2.63
	Y3	14.97	15.03	-0.05	-0.37	2.27	2.21	0.06	-2.86
	Y4	16.33	15.68	0.65	3.95	2.02	1.97	0.06	-2.72
	Y5	15.19	14.02	1.18	7.74	2.10	1.98	0.12	-5.71

$t_{3,4/1,2}$ – assuming that the distance was travelled with V max

Tab. 3. The differences between the experimental and control group in the analysed variables

Group		N	Average	SD	Min	Max	U Mann-Whitney Statistics Z
$t_{34/12}$ [s]	experimental	5	0.69	0.51	0.13	1.51	Z=1.044, p=0.296
	control	5	0.26	0.64	-0.41	1.18	
	total	10	0.47	0.59	-0.41	1.51	
$l_{34/12}$ [m]	experimental	5	0.04	0.10	-0.12	0.11	Z=0.731, p=0.463
	control	5	-0.03	0.09	-0.12	0.11	
	total	10	0.01	0.10	-0.12	0.11	
$t_{34/12}$ [%]	experimental	5	4.34	2.95	0.81	8.99	Z=-1.149, p=0.310
	control	5	1.63	4.19	-2.78	7.74	
	total	10	2.99	3.70	-2.78	8.99	
$l_{34/12}$ [%]	experimental	5	2.63	5.03	-5.78	6.38	Z=-0.731, p=0.548
	control	5	-1.38	4.87	-5.71	7.03	
	total	10	0.63	5.12	-5.78	7.03	

p – level of statistical significance for the Z variable

The results of average values from Table 3 appear in Figure 4.

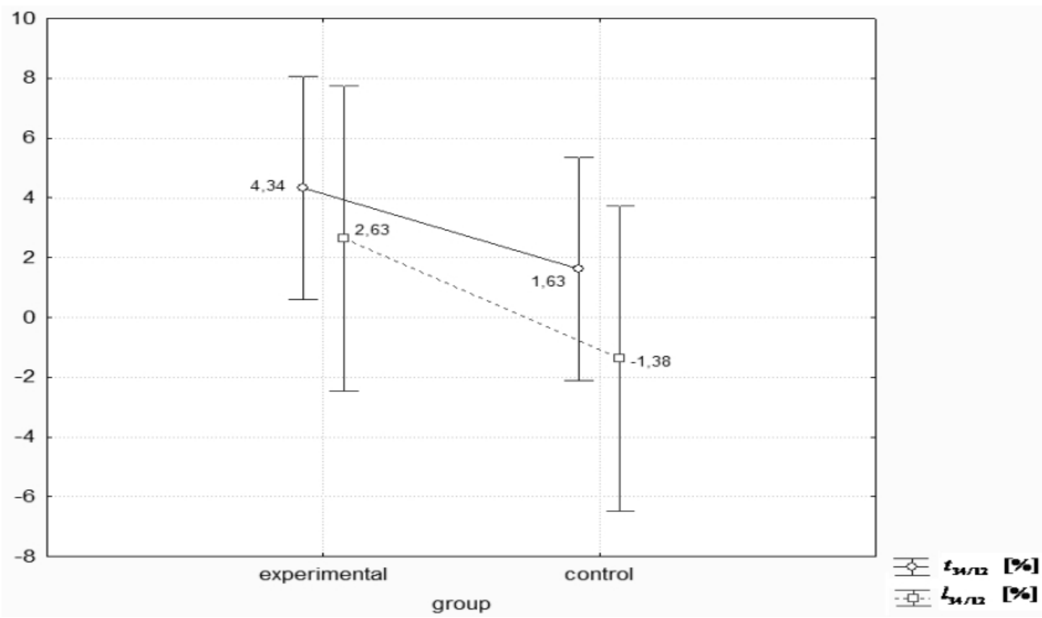


Fig. 4. Results of average values of time needed to cover the given distance and the stroke length in both the experimental and the control group

Discussion

This paper focuses on creating a teaching method and improving the swimming technique with the help of transmission of immediate verbal feedback (IVF). The issues which are dealt with in the present project are connected with three aspects which impede the process of teaching-learning a movement cycle: 1) occurrence of didactic communication disorder in the process of teaching and improving swimming cycles; 2) delivery of delayed verbal information feedback; 3) incorrect movement habit as the final effect of the learning process and improving swimming cycles.

This should pave the way for defining the meaning which immediate verbal feedback has in the process of teaching and improving the swimming cycles. The authors work on a wireless transmitter for subjects participating in the process of teaching and improving swimming cycles are a step in that direction.

It was assumed that the confirmation of the usefulness of the proposed method and the utilization of a transmitter will enrich the technology of transmitting information in physical education and swimming sports. It allows breaking communication barriers, immediately removing errors in a movement cycle, which results in creating proper movement habits.

The present research studied the influence of immediate verbal feedback on the efficiency and effectiveness of swimming. The experimental group proved to increase the average stroke length by 2.63% (4 cm) and the average time needed to cover the distance of 25 meters dropped by 4.34% (0.69 s). The control group revealed a decrease in the average swimming cycle by 1.38% (3 cm) and a decrease in the average time needed to cover the distance of 25 meters by 1.63% (0.26 s) (Figure 4). According to Avischious [29], the improvement in a single swimming cycle by 2.5 cm without a change in the stroke rate results in an improvement of the result at the distance of 50 m by 0.4 s and at the distance of 200 m by 1.5 s. Among the test subjects from the experimental group the average stroke length increased by 4 cm, which can have a substantial and decisive meaning during the race.

Swimming is an example of a movement cycle in which extrinsic verbal feedback can be treated as a kind of facilitation in the process of learning new movement cycles or improving the already known ones [12, 13, 14]. Many of these studies were possible thanks to technological progress which resulted in creation of useful tools in the work of swimming teachers and coaches, allowing them to deliver immediate verbal feedback in difficult conditions of a swimming pool. Likewise, technological progress was essential for this study as a waterproof transmitter was developed for the needs of verbal communication with the swimmer executing the movement cycle. This device can become a useful tool in the hands of a teacher, instructor or swimming coach, giving an opportunity to deliver immediate verbal feedback about the correct characteristics or the errors in the movement cycle.

Exercising incorrect repetitions can have long-term consequences, such as undesired strengthening of errors. The higher the number of incorrect repetitions, the more automatic the error and the more difficult the correction becomes. Therefore, a great deal of self-learners experience difficulties during classes with a teacher. It is so because they have saved the incorrect programs of movement cycles in their muscle memory, which results in producing an incorrect movement cycle [4]. Interferences occur in the situation where seemingly similar but essentially different programs cross and distort each other, which impedes the correct execution of the technique [4].

Immediate verbal feedback after the occurrence of the error with correction of the incorrectly executed movement cycle has a substantial influence on the process of learning a movement cycle because it is included in the range of short memory [30]. A delayed time of the delivery of verbal feedback causes changes but only in the long range memory which is connected with elongation of the time needed to remove the erroneous movement cycle. The delivery of immediate verbal feedback can allow the removal of the errors saved in muscle memory by the learner and thus, the effects of the work should be quickly visible. It is suggested that at the beginning of the phase of learning complex movement cycles, a student receives additional benefits from immediate verbal feedback [31].

Immediate correction of the movement cycle induced by the delivery of immediate verbal feedback can affect the correct movement cycle, becoming a valid movement habit, that is, a movement cycle executed without full participation of consciousness. It can be illustrated by the movement habit of controlling the stroke length or maintaining the so-called "high-elbow" in the preparatory phase and correct movements of the upper limbs during swimming front crawl. According to Schmidt's theory of schemes, in the process of repeated movement cycles the repetitions of a movement cycle which are called motor schemes are created in the long-term muscle memory [32]. They serve the role of implementation and evaluation of the movement cycle. The concept of motor scheme stands for the inner representation for the specific class of movements including the collection of rules defining the relations between different kinds of information and its influence on the process and the outcome of movement [32].

The presented method of teaching and improving swimming cycles with the use of delivery of immediate verbal feedback and subsequently its pragmatic quality and possibility of technological transfer reveals yet another suggestion. It can be used by physical education teachers and swimming coaches. Because of the extensive amount of unknown issues associated with didactical communication in teaching and improving swimming cycles, research in this matter should be conducted. The proposed method with immediate verbal feedback (IVF) and a transmitter should be used in order to verify a further hypothesis concerning the improvement in achievements by students and persons perfecting their swimming cycles.

Conclusions

1. The delivery of immediate verbal feedback during front crawl swimming at the distance of 25 m results in an increase in average stroke length and a decrease in the average time needed to cover the distance
2. The utility of a wireless transmitter used between the teacher and the swimming student was confirmed.
3. The proposed method with the delivery of IVF and the use of a communication device will enrich the technology of transmitting information in physical education and swimming sports.

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