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Plans for estimating physical-technical loads in Swimming
Los planes de estimación de las cargas físico-técnicas en la Natación

Ariel Armando Cabanas-Barreto [1], ***Paul Germán Rivadeneira-Rivadeneira*** [2]

[1] ***Univ. Provincial Sports Federation of Morona Santiago. Macas, Ecuador.***
[2] ***Univ. Provincial Sports Federation of Morona Santiago. Macas, Ecuador.***

Email:
acabanas@est.ups.edu.ec
privadeneirar@est.ups.edu.ec

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ABSTRACT

In the sport of Swimming, insufficiencies currently persist in the planning of training loads, especially those of a physical-technical orientation. The scientific problem identified was: how to contribute to the process of developing plans for estimating physical-technical loads in Swimming? To provide an answer and solution as an objective, a methodology was designed. Analytical-synthetic, hypothetical-deductive, document analysis, systemic-structural-functional, specialist criteria, survey and the Delphi statistical method were used. The specialist criteria revealed a high level of agreement in the theoretical relevance and prognosis of practical feasibility of the methodology.

Keywords

Estimation plans; Physical-technical loads; Swimming.

RESUMEN

En el deporte Natación persisten actualmente insuficiencias en la planificación de las cargas de entrenamiento sobre todo en las de orientación físico-técnica. El problema científico identificado fue: ¿cómo contribuir al proceso de elaboración de los planes de estimación de las cargas físico-técnicas en la Natación? Para darle respuesta y solución como objetivo se diseñó una metodología. Se utilizaron los métodos y/o técnicas de investigación analítico-sintético, hipotético-deductivo, análisis de documentos, sistémico-estructural-funcional, criterios de especialistas, encuesta y el método estadístico Delphi. Los criterios de especialistas revelaron alto nivel de concordancia en la pertinencia teórica y pronóstico de factibilidad práctica de la metodología.

Palabras clave

Planes de estimación; Cargas físico-técnicas; Natación.

INTRODUCTION

Properly planning the loads of sports training is one of the essential professional pedagogical skills that coaches must develop. However, in the current context of sport, a methodological procedure is not always developed that allows an adequate selection of the content or exercises, an optimal determination of the volumes, intensities, rests, frequencies and duration of the loads, according to the moment or stage of training and taking into account the demands of the sport modality and individual characteristics of the athletes.

The above reveals the need to continue with scientific-methodological efforts that allow the improvement of the planning of the loads so that they are as realistic, controllable and individualized as possible as a current challenge of this management process that determines the quality of sports training and the performance of athletes.

For the development of this work on the object of study of the planning of training loads, the sport of Swimming was taken, a discipline of high level of complexity in which a variety of energetic and physical efforts are developed, and different technical styles such as crawl or freestyle, backstroke, breaststroke and butterfly. All this reveals the need to establish the ranges of external and internal indexes of the loads (especially those of physical-technical orientation) in correspondence with the demands of the distances of each event. But not all Swimming coaches have the knowledge and skills to develop the fulfillment of these scientific-methodological demands of the planning of the loads.

The above was evidenced as a **problematic situation** of the present investigation, which revealed: deficiencies in the process of elaboration of the plans of estimation of the physical-technical loads in the sport of Swimming of the Provincial Federation of Morona Santiago, Macas, Ecuador.

The main manifestations of the deficiencies detected in the documentary analysis carried out on the sports training plans (written plan, graphic plan or macrocycle, microcycles, training class plans) were:

- The contents of training with loads of physical-technical orientation are not specified in accordance with the energetic and physical demands of the different events.
- The necessary correlation of the different indices of the physical-technical load in its external and internal manifestations according to the distance and competitive modality is lacking.
- Poor treatment in the planning of the physical-technical loads at the beginning of individualization, given that the same volume, intensity, and rest are appreciated for all athletes.

Among the scientific-methodological causes of these deficiencies are the shortcomings in the methodology or methodological procedures to develop the plans for estimating the physical-technical loads that the trainers learned in their undergraduate and/or postgraduate professional training process. To support this approach, it is important to develop a synthetic analysis of the state of knowledge.

In the scientific literature specialized in the planning of physical training loads, the following methodological procedures have been identified:

1. Distribution and dosage of the physical load based on percentages of the general volume of the macrocycle using training time as a magnitude (Forteza and Ranzola, 1988; Forteza, 2001; Forteza and Ramírez, 2007).

The first methodological approach mentioned has a significant limitation. Using time as a measure is not appropriate for planning volume, since it only indicates the duration of training, for example, 10 hours to train strength endurance. Therefore, expressing volume in terms of time for strength endurance does not reflect reality, nor does it allow for effective control or adequate individualization.

2. Distribution and dosage of the physical load based on percentages of the theoretical volume of the macrocycle using magnitudes (repetitions, distances, time) according to the nature of the content of the loads (García et al, 1996; Romero, 2006; Collazo et al, 2006).

This second methodological approach manages to assign the appropriate importance to the content of the different manifestations of the load, since for example the volume is expressed in repetitions, distances, time, etc. However, it does not guarantee that, by distributing the percentages of the general volume, the microcycle or training session will be reached with the ideal number of repetitions or distances to achieve the objectives and apply a specific method, since there may often be too many or too few repetitions or distances. In addition, not all stages or mesocycles have the same number of weeks or microcycles, which can create mathematical conflicts when distributing and dosing the physical load. It is also not clear how to individualize the planning. 3. Distribution and dosage of the load based on estimates of volume and intensity in the different microcycles or work weeks by stages of preparation (Oroceno, 2003; Navarro et al, 2010; Romero and Becalli, 2014; Bompa, 2016; Collazo, 2020, 2021; Heredia, 2023).

The third methodological approach takes load plans as a starting point, which constitute an adequate innovation, since it allows determining, for example, a volume of repetitions, distances or another more realistic magnitude of the loads. It starts by properly assigning what can truly be done by a

subject or group in a training session or work microcycle, even with minimum and maximum permissible ranges of volume, intensity, rest, frequency and duration, which does allow for treatment of the individualization of loads for various groups of athletes.

However, coaches have the challenge of generating this methodological approach in a specific and innovative way for their sporting modality. And the main challenge is to identify the methodological procedure to arrive at the elaboration of the plans for estimating the training loads.

In the specific context of the planning and control of the physical-technical loads in Swimming, the works of Navarro & Rivas (2001), Wallace et al (2008), García et al (2015), Feijen et al (2020), Gonjo et al (2020), Olstad et al (2020), Barry et al (2021), Leite et al (2022), Navarro (2023) were consulted. These important references reveal examples, considerations and key indices of the different components of the load, but they do not go into depth on the methodological procedure to elaborate the plans for estimating the loads.

Based on the identification of the problematic situation and the analysis of the state of knowledge, the following **scientific problem** was formulated: how to contribute to the process of developing plans for estimating physical-technical loads in Swimming?

Since the main cause of the manifestation of the scientific problem lies in the methodological aspect so that the planning of training loads is real, controllable and individualized, the **general objective** is to develop a methodology that contributes to the process of developing plans for estimating physical-technical loads in Swimming.

METHODS

The following scientific research methods and/or techniques were used in the research carried out:

- **Analytical-synthetic:** used to analyse the theoretical and research background in the area of knowledge, to study the foundations that supported the methodology **developed;** and to interpret the results of the application of the survey to specialists and the statistical processing on the theoretical relevance and practical feasibility forecast of the methodology.
- **Inductive-deductive:** used to establish the generalisations and conclusions that were derived from the results of the application of the survey to specialists on the theoretical relevance and practical feasibility forecast of the methodology that was developed.
- **Document analysis:** used to analyse the planning of physical-technical orientation loads in the sport of Swimming in written and graphic training plans, in microcycle plans and in training classes.

- **Scientific modeling and systemic-structural-functional:** were used to determine the structural components of the methodology that was developed and the systemic relationships between the components and methodological procedures that make it up that allowed the ideal representation of the planning process of the physical-technical orientation loads in the sport of Swimming.
- **Specialist criteria:** was used to assess the theoretical relevance and the forecast of feasibility of practical application on different aspects of the developed methodology.
- **Survey:** was used as a technique to obtain the criteria of the specialists who assessed the theoretical relevance and the forecast of feasibility of practical application of the methodology that was presented to them.
- **Delphi method:** was used in the statistical processing of the results of the criteria of the selected specialists.

RESULTS

A methodology was provided to contribute to the solution of the formulated scientific problem. This scientific research result describes, according to Valle's assumption (2007), how to do something, the establishment of paths, methods and procedures to achieve an end, in which the contents are taken into account to achieve a certain objective.

The contribution of the methodology conceived in the context of the planning of loads of physical-technical orientation in the sport of Swimming, is oriented to give an answer to how to ideally develop this process.

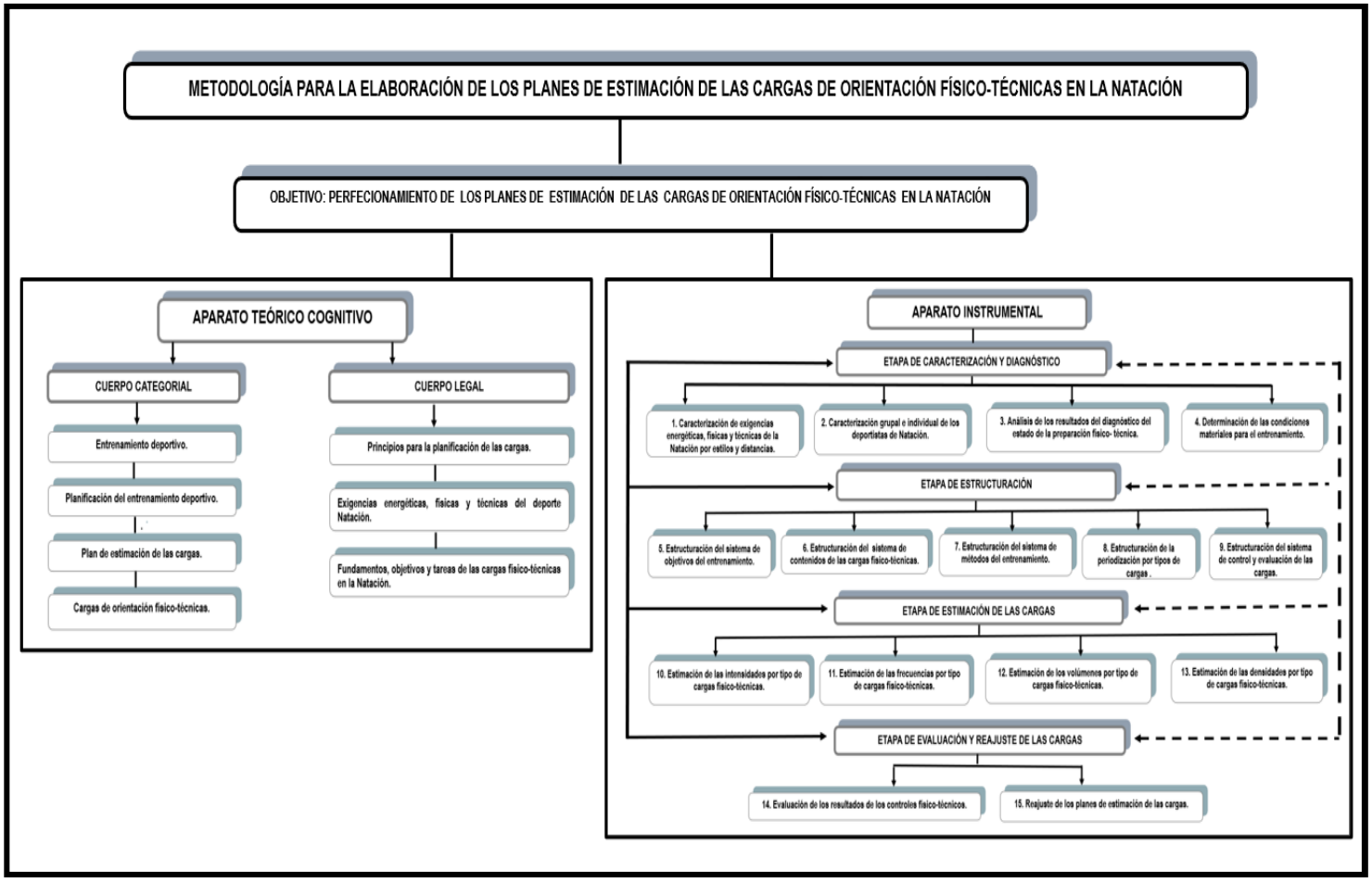
In the design of the methodology, the theoretical-methodological guide proposed by De Armas et al (2001) was used for the structuring and determination of the cognitive and procedural content of the methodology. In this regard, this reference states that the methodology as a scientific result of an investigation is made up of two structural apparatuses called: theoretical cognitive apparatus and methodological or instrumental apparatus.

The conformation of the cognitive theoretical apparatus contains the categorical body that in turn includes the categories and concepts and the legal body that is composed of laws, principles or requirements. The concepts and categories that form part of the cognitive theoretical apparatus of the methodology are those that define essential aspects of the object of study. On the other hand, they explain that the legal body is made up of the principles or requirements that regulate the process of application of the methods, procedures, techniques and means. (De Armas et al, 2001)

As for the methodological or instrumental apparatus, it is made up of the theoretical and empirical methods, the techniques, procedures and means that are used to obtain knowledge or to intervene in practice and transform the object of study. (De Armas et al, 2001)

Figure 1

General representation (model) of the methodology for the development of plans for estimating physical-technical orientation loads in the sport of Swimming.



As can be seen in Figure 1, the methodology developed has the general objective of improving the plans for estimating physical-technical loads in the sport of swimming.

As can be seen in the graph of the methodology model, the cognitive theoretical apparatus is made up of its categorical body and its legal body. The categorical body contains the concepts of sports training, sports training planning, load estimation plans and physical-technical loads. These categories are defined below to locate the context of the area of knowledge in which the methodology is developed:

Sports training: "is a complex and specialized pedagogical process aimed at improving the physical, technical, tactical, theoretical, psychological, educational potential and the formation of ethical and aesthetic values in athletes with the purpose of achieving optimal and adequate sports form at the desired time and for the competition." (Collazo, 2021)

Sports training planning: "(…) represents the action plan or project that is carried out with the training process of an athlete (or sports team) to achieve a certain objective (high performance)." (García et al, 1996)

Training load estimation plan: "it is one of the methodological guidance documents for the coach to develop the planning. It reflects the permissible ranges of the different components of the load (volume, intensity, duration, frequency and rest), according to the characteristics of the sport or sports specialty, the particularities of the content or direction of the training, the diagnosis of the athletes, the pedagogical and sports mastery of the coach and the scientific criteria assumed." (Heredia, 2023)

Physical-technical orientation loads: "they are contents or directions of sports training aimed at developing physical capacities through stimuli or exercises similar to the competitive technical actions of a sport from an energetic and/or biomechanical point of view." (Heredia, 2023)

For its part, the legal body of the methodology is essentially made up of a set of principles that guide the development of the plans for estimating physical-technical loads. To do this, principles described by Collazo (2020) are assumed, they are:

1. Principle of adequate content selection.
2. Principle of the relationship between training potential and recovery.
3. Principle of gradual and gradual increase in loads.
4. Principle of adequate dosage of loads.
5. Principle of individualized nature of loads.
6. Principle of the need for balance between energy expenditure and consumption during the practice of physical sports exercises.

7. Principle of frequent control and evaluation of loads.

On the other hand, regarding the structure and content of the methodology, figure 1 also shows the instrumental apparatus. This structure of the methodology is organized in a systemic way by stages with their corresponding methodological procedures. Therefore, the instrumental apparatus reveals the procedure to develop the planning of loads of physical-technical orientation in Swimming. It is proposed that the system of methodological procedures that are organized by stages in the methodology is an organized and structured set of steps or actions, detailed and sequential, to guide the execution of the procedures in an efficient, coherent manner, and with the objective of obtaining consistent sports performance and results.

The **specific objective** of the characterization and diagnosis stage is to: Characterize the key information of the context in which the planning of the physical-technical orientation loads in Swimming must be developed. The **methodological procedures** to be developed in this stage are:

1. Characterization of the energetic, physical and technical demands of Swimming by styles and distances.
2. Group and individual characterization of Swimming athletes.
3. Analysis of the results of the diagnosis of the state of physical-technical preparation.
4. Determination of the material conditions for training.

The **specific objective** of the structuring stage is to: **structure the process** of preparing the plans for estimating the physical-technical orientation loads, based on the information provided by the development of the previous stage, to determine the objectives, the temporal structure of the planning, the contents, the methods, and the forms of control and evaluation that will be used in the development of the preparation of the load plans. The **methodological procedures** to be developed in this stage are:

1. Structuring the system of training objectives.
2. Structuring the system of contents of the physical-technical loads.
3. Structuring the system of training methods. 8. Structuring the periodization by type of loads.
4. Structuring the system of control and evaluation of the loads.

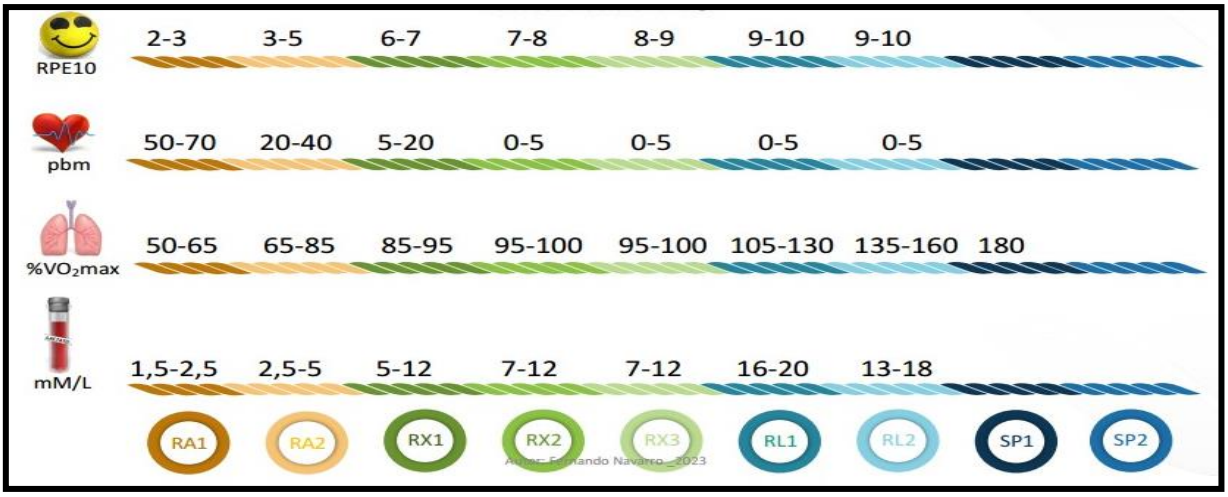
The **specific objective** of the **load estimation stage** is to develop the scientific-methodological treatment of the planning of the ranges of the different components of the loads of physical-technical orientation in correspondence with the distance, style and stage of training.

The **methodological procedures** to be developed in this stage are:

1. Estimation of the intensities by type of physical-technical loads.
2. Estimation of the frequencies by type of physical-technical loads.
3. Estimation of the volumes by type of physical-technical loads.
4. Estimation of the densities by type of physical-technical loads (Figures 2, 3 and 4).

Figure 2

Example of estimation of ranges of intensity indexes of physical-technical loads in high-performance swimming.

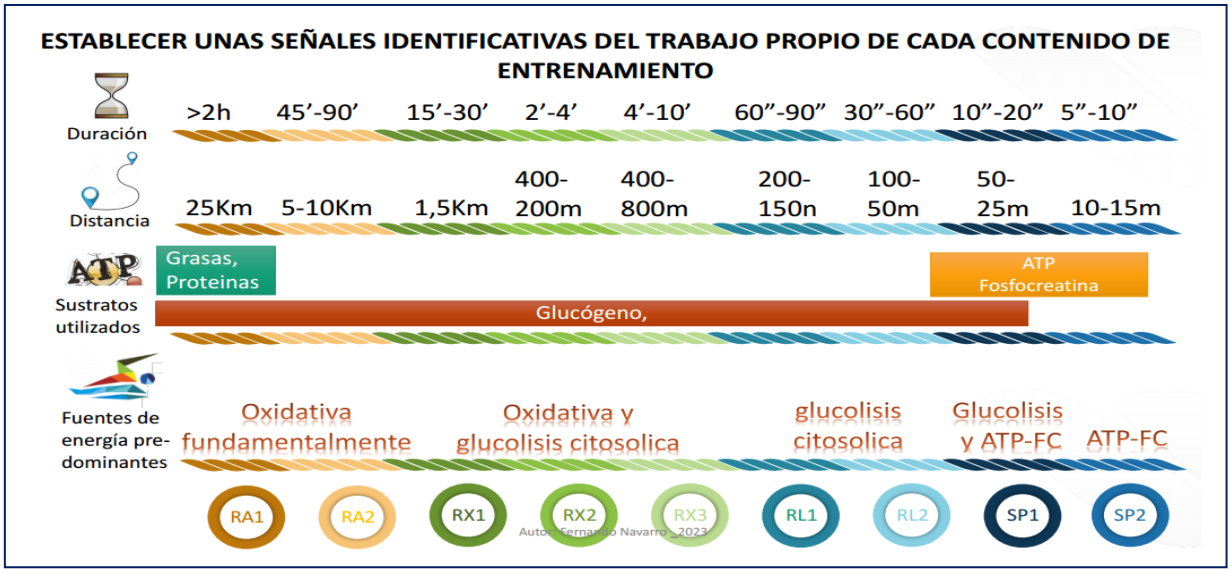


Source: Navarro (2023).

Legend: RA1-Aerobic Resistance 1, RA2-Aerobic Resistance 2, RX1-Mixed Resistance 1, RX1-Mixed Resistance 2, RX1-Mixed Resistance 3, RL1-Lactic Resistance 1, RL1-Lactic Resistance 2, SP1-Sprint 1, SP1-Sprint 2, RPE10-Perception of Effort on a 10-point scale, Bpm-Beat rates per minute, %V2max-Percentage of Maximum Oxygen Consumption, mM/L-Lactate Concentration.

Figure 3

Example of estimation of duration and volume ranges in distances of physical-technical loads in high-performance swimming.



Source: Navarro (2023).

Legend: RA1-Aerobic Resistance 1, RA2-Aerobic Resistance 2, RX1-Mixed Resistance 1, RX1-Mixed Resistance 2, RX1-Mixed Resistance 3, RL1-Lactic Resistance 1, RL1-Lactic Resistance 2, SP1-Sprint 1, SP1-Sprint 2.

Figure 4

Example of a plan for estimating physical-technical loads in energy zones of power and anaerobic capacity in high-performance swimming.

ZONAS DE ENTRENAMIENTO	Duración del estímulo (mm:ss)	Distancia del estímulo (m)	Velocidad	Descanso (min:ss)	Volumen por serie (m)	Descanso por serie (mm.ss)	Volumen total (m)	Frecuencia cardiaca (bpm)	Concentración lactato (mM/l)	Ejemplos de tareas
PAE	2:00-3:00	150-200	Valt	1:00-3:00	600	5:00-10:00	1000-1600	>185	>6	2x(3x200/3:00)/10:00
	0:30-2:00	50-100		0:15-0:45	300-500					2x(4x100/0:15)/5:00
CLA	1:00-2:00	100-150	Valt	1:00-3:00	400-800	7:00-10:00	1000-2000	Máx.	>8	3x(4x100/3-2-1)/10:00
	0:30-0:45	50-75		0:10-0:15	200-400	4:00-8:00				3x(6x75/0:15)/8:00
PLA	0:45-1:00	75-100	Valt	1:30-3:00	200-300	8:00-15:00	600-1000	Máx.	>8	3x(3x75/1:30)/10:00
	0:30	50	Vsub	0:30	150-200					4x(3x50/0:30)/10:00
CAL	0:20	25-40	Vmax-Vsub	3:00	-	-	200-400	-	4-6	8x25/3:00
			Vsub	1:00	100	3:00-4:00				3x(4x25/1:00)/4:00
	0:10	15-20	Vsub	0:30	-	-				10x15/0:30
PAL	<0:10	15-20	Vmax	3:00	-	-	200-300	-	2-4	10x15/3:00
				1:00	30 -60	5:00-7:00				4x(3x15/1:00)/5:00

Source: Navarro (2010).

Legend: PAL- Alactic Anaerobic Power, CAL- Alactic Anaerobic Capacity, PLA- Lactic Anaerobic Power, CLA- Lactic Anaerobic Capacity, PAE- Aerobic Power.

The **specific objective of the load assessment and readjustment stage** is to provide feedback to the process based on systematic control and assessment of the load estimation plans carried out at each stage, microcycle and training classes.

The **methodological procedures** to be developed at this stage are: Evaluation of the results of the physical-technical controls. 15. Readjustment of the load estimation plans.

The evaluation of the theoretical relevance and the prognosis of the feasibility of practical application of the proposed methodology was developed with the method of specialists' criteria. The group of 11 selected specialists presents the following characterization: seven (7) of them have the title of Doctor in Physical Culture and Sport, four (4) of them have a Master's degree in Sports Training, all of them have 10 or more years of professional experience as undergraduate and graduate teachers in "Theory and Methodology of Sports Training".

The selected specialists were given a survey aimed at evaluating different aspects that reveal the theoretical relevance and the prognosis of the feasibility of practical application of the methodology. The Delphi method was applied to the results obtained in the surveys for the statistical processing of the data of the given criteria and to establish the level of concordance of the specialists (Table 1).

Table 1

Results of the evaluation of the methodology by the specialist criterion method (cut-off points obtained with the Delphi statistical method).

ASPECTOS A VALORAR POR LOS ESPECIALISTAS	MA	BA	A	PA	NA	SUMA	P	N-P	VALORACIÓN
1. La fundamentación teórica y metodológica.	0.91	1.34	3.49			5.73	1.43	-0.32	Muy adecuado
2. Formulación del contenido y secuencia lógica de los procedimientos de la metodología.	0.60	1.34	3.49			5.43	1.36	-0.24	Muy adecuado
3. Los efectos de la metodología.	0.91	1.34	3.49			5.73	1.43	-0.32	Muy adecuado
4. La aplicabilidad de la metodología.	0.60	1.34	3.49			5.43	1.36	-0.24	Muy adecuado
5. La viabilidad de la metodología.	0.60	1.34	3.49			5.43	1.36	-0.24	Muy adecuado
6. La relevancia de la metodología.	0.91	1.34	3.49			5.73	1.43	-0.32	Muy adecuado
PUNTOS DE CORTE	**0.76**	**1.34**	**3.49**	**0**	**0**	**N=**	**1.12**		**Muy adecuado**

Legend: MA - Very Adequate, BA - Quite Adequate, A – Adequate, PA - Slightly Adequate, NA – Not Adequate.

According to the statistical cut-off points obtained, the values of the score given to each aspect of the methodology that was developed were concentrated predominantly in the range of Very Adequate, indicating a very high level of adequacy according to the established criteria, therefore, a high consensus or agreement was reached among the specialists in this category. The results presented

demonstrate the high level of theoretical relevance of the methodology and its high potential to achieve positive effects in its subsequent practical application by swimming coaches.

DISCUSSION

A methodology was developed that contributes to the process of developing plans for estimating physical-technical loads in swimming. The methodology reveals the procedure to establish the minimum and maximum ranges of the different indicators (external and internal) of the training loads, which guarantees that the requirements that planning must be as realistic, controllable and individualized as possible so that it has a positive impact on sports performance are met. Therefore, the proposed methodology surpasses previous methodological procedures for planning sports training loads.

In order to develop the training load estimation plan in the designed methodology, firstly, the appropriate magnitude is assigned to the volume of the load taking into account its nature (repetitions, distance, time) by energetic efforts and specific manifestations of physical capacities, thus achieving a more realistic planning than that proposed by Forteza and Ranzola (1988), Forteza (2001) and Forteza and Ramírez (2007) who only limit themselves to the magnitude of time to express the volume of the load.

Secondly, permissible ranges of volume are established that can actually be executed in a training session or microcycle, based on the experience of the coaches in the pedagogical practice, the systematic control of the athletes and the assumed scientific criteria. This methodological procedure exceeds what was proposed by García et al (1996), Romero (2006) and Collazo et al (2006), since they are limited to a distribution and dosage of the physical load based on percentages of a theoretical volume of the contents or directions in the macrocycle, which leads to the fact that when it comes to planning the loads of the microcycle and the training sessions, there are excess or lack of repetitions, distances and time.

Thirdly, the distribution and dosage of the load is specified based on estimates of the volume and intensity in the different types of microcycles or weeks of work by stages of preparation, taking into account the characteristics and demands of the sport of Swimming in its different competitive modalities (styles and distances). This allows the methodological contributions of Oroceno (2003), Navarro et al (2010), Romero and Becalli (2014), Bompa (2016); Collazo (2020, 2021) and Heredia (2023) to be assumed and applied in a contextualized way to Swimming. Finally, in the proposed methodology, the scientific-methodological criteria specific to the planning and control of physical-technical orientation loads in Swimming provided by Navarro & Rivas (2001), Wallace et al (2008),

García et al (2015), Feijen et al (2020), Gonjo et al (2020), Olstad et al (2020), Barry et al (2021), Leite et al (2022) and Navarro (2023) are considered in order to establish, as part of the designed methodology, the minimum and maximum permissible ranges of each load component of each content or direction of training with an emphasis on the physical-technical relationship. In summary, the methodological procedures in the new methodology are organized in a logical and systemic way in stages to promote the development of plans for estimating the physical-technical load in accordance with the energetic and physical-technical demands, with the specific characteristics of the styles and the level of the athletes in the sport of Swimming. Therefore, with respect to the studies that constituted theoretical and investigative background, the scientific result achieved in the present research overcomes the existing deficiencies, since the load plans are developed with a better methodological sequence.

The theoretical relevance and the feasibility forecast for practical application of the methodology were positively assessed by the 11 highly academic and scientific specialists who were consulted. The results obtained from the application of the specialist criteria method denote a high level of acceptance of the proposal.

It is also recommended to develop prior training and practical application of the methodology in different populations of physical-sports trainers in the sport of Swimming, taking into account the age category and sex, styles and distances in which they specialize, to measure its impact on professional training planning skills and on sports performance.

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