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Theoretical conception for figures training in school-level artistic swimming

[*Concepción teórica para el entrenamiento de las figuras en la natación artística escolar*]

[*Concepção teórica para o treinamento de figuras na natação artística escolar*]

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ABSTRACT

Introduction: This article was carried out based on identifying theoretical, methodological, and practical shortcomings in the technical preparation process of school artistic swimming.

Objective: To develop a theoretical concept with a new way of restructuring the content for the training of figures, based on their periodization, which favors the increase of sports performance in school-age artistic swimmers.

Materials and Methods: The theoretical methods of scientific research used were analytical-synthetic and systemic-functional. Empirical methods included documentary analysis and expert criteria. Mathematical-statistical methods involved descriptive and inferential statistics, using the Kendall's W Test.

Results: The quality of the theoretical concept was confirmed by the evaluation issued by the 15 selected experts, who had a direct relationship either with sports training or in a particular way in the training of Cuban artistic swimming.

Conclusions: Experts evaluating the indicators emphasize their functionality, relevance, and feasibility.

Keywords: concept, technical training, water sports.

RESUMEN

Introducción: el presente artículo se realizó a partir de detectar insuficiencias teórico-metodológicas y prácticas en el proceso de preparación técnica de la natación artística escolar.

Objetivo: elaborar una concepción teórica con una nueva forma de reestructurar el contenido para el entrenamiento de las figuras, sobre la base de su periodización, que favorezca el incremento del rendimiento deportivo en nadadores artísticos categoría escolar.



Materiales y métodos: se emplearon como métodos teóricos de la investigación científica el analítico-sintético y el sistémico estructural funcional. De los empíricos, el análisis documental y el criterio de expertos. Como métodos matemático-estadísticos, la estadística descriptiva e inferencial, con la Prueba de W de Kendall.

Resultados: la calidad de la concepción teórica quedó corroborada por la evaluación emitida por los 15 expertos seleccionados, que tuvieron relación directa ya sea con el entrenamiento deportivo o de modo particular en el entrenamiento de la natación artística cubana.

Conclusiones: los expertos en la evaluación de los indicadores, resaltan su funcionalidad, pertinencia y factibilidad.

Palabras clave: concepción, entrenamiento técnico, deportes acuáticos.

RESUMO

Introdução: este artigo foi elaborado a partir da detecção de insuficiências teórico-metodológicas e práticas no processo de preparação técnica da natação artística escolar. **Objetivo:** desenvolver uma concepção teórica com uma nova forma de reestruturação do conteúdo para o treinamento de figuras, a partir da sua periodização, que favoreça o aumento do desempenho esportivo em nadadores artísticos da categoria escolar.

Materiais e métodos: métodos analítico-sintéticos e sistêmicos estrutural-funcionais foram utilizados como métodos teóricos de pesquisa científica. Análise empírica, documental e parecer pericial. Como métodos matemático-estatísticos, estatística descritiva e inferencial, com Teste W de Kendall.

Resultados: a qualidade da concepção teórica foi corroborada pela avaliação emitida pelos 15 especialistas selecionados, que tiveram relação direta quer com o treino desportivo, quer de forma articular com o treino da natação artística cubana.

Conclusões: os especialistas na avaliação dos indicadores destacam a sua funcionalidade, relevância e viabilidade.



Palavras-chave: concepção, treinamento técnico, esportes aquáticos.

INTRODUCTION

The Royal Spanish Academy (2023) associates conception with the action of conceiving, and the latter is defined as the result of forming an idea, a concept whose essence provides an overall view of the term under analysis. Theoretical conceptions are understood as any system of ideas, concepts, and representations about the surrounding world that can encompass the whole reality or an aspect of it.

In this regard, a bibliographic search was conducted regarding the definition of theoretical conception as a scientific result. The main consulted authors were (Capote, 2012; Macías, 2019; Aliaga, 2023; and Torres, 2023). From the analysis carried out, a set of aspects that constitute regularities in theoretical conceptions is deduced:

- They establish a system of ideas and concepts about a specific aspect of reality.
- They have a theoretical and methodological character. They are defined as theoretical, didactic, pedagogical, methodological, or theoretical-methodological.
- They include fundamental components: premises, principles, categories, and methodological resources.

Regarding this, Capote (2012) establishes rules or guidelines to form a theoretical conception:

1. Objective: It indicates what is intended to be achieved through its elaboration, that is, how the object would be transformed after its practical implementation.
2. Foundation: It includes the essential elements of the theory that serve as the basis for enriching the theoretical and empirical framework.
3. Structural components of the conception: It lays out the system of scientific ideas, as well as the concepts (definitions, categories), judgments (principles, laws, requirements, among others), and other elements that comprise it.



4. Graphic representation: It is illustrated by a graph or diagram that shows the relationships between its components to justify the existence of a true system of ideas.
5. Objectification of the conception: It establishes all the necessary general considerations for the conception to be implementable in practice.

Placing it in the sphere of theory and methodology of sports training, it was observed that (Bompa & Buzzichelli, 2016; Vinuesa & Vinuesa, 2016; Capote *et al.*, 2017; Camacho *et al.*, 2019; Rodríguez *et al.*, 2022, and Rodríguez *et al.*, 2023) offer theoretical conceptions of training for physical-technical development in different sports disciplines. However, these are still lacking in the logical specificity of the content of each sport and the complexity of its execution, as well as its implications on technical development based on biological age and level achieved during the teaching-learning process.

In international artistic swimming, scientific contributions according to (Solana *et al.*, 2019; Li *et al.*, 2020; Escrivá & González, 2020; García *et al.*, 2021; Podrihalo *et al.*, 2021; Ponciano *et al.*, 2021, and Romero *et al.*, 2022) improving methods to predict competitive success and highlight the anthropometric, physiological, metabolic, nutritional, and genetic profile attributes of artistic swimmers for physical-technical preparation. However, the studied methodological conceptions do not conceptualize what these consist of; pragmatism prevails and there is a lack of theories on new considerations such as: the integration of technical preparation from a didactic and psychological approach to the training of figures. Thus, the need for this article arises.

Other national authors such as (Brito, 2020; Fons & Ruiz, 2021; Nápoles & Ruiz, 2022; Hernández *et al.*, 2023, and Hernández *et al.*, 2023) provide solutions that address the physical-technical limitations in the sports preparation of artistic swimmers. However, they are still insufficient in the didactics of technical training that allows for a gradual and undulatory planning of loads and adheres to the psychopedagogical principles of sports training.



Another aspect to highlight is regarding normative documents (FINA, 2021 and FINA, 2022) for artistic swimming training, which only state the figures to perform. However, in terms of how the figures are evaluated, there is still a lack of specific exercises with a new dynamic for design and control, aspects that should stem from a theoretical conception.

The extraordinary value of the contributions made by the mentioned authors in the preceding paragraphs is unquestionable; however, a clear conception for the training of figures in artistic swimming is still lacking. Moreover, the didactic methodological treatment to refine the aforementioned is insufficient. These elements indicate the need for a theoretical systematization in the training of this sport.

The aim of this research was to develop a theoretical concept with a new way of restructuring the content for figures training, based on its periodization, to enhance the sports performance of school-level artistic swimmers.

MATERIALS AND METHODS

Fifteen experts were selected using the expert criteria method with the Delphi methodology. The following methods were employed for this study:

From a theoretical perspective, the analytical-synthetic method was utilized to delve into all the moments of the research process. The systemic-structural functional method was employed to model the theoretical conception; determining the structure and hierarchy of each component, as well as its dynamics and operation.

In terms of the empirical level, the documentary analysis method allowed for a bibliographic review of the background study related to figures training in artistic swimming. The review involved consulting research articles published in national and international journals related to artistic swimming preparation. Additionally, the study



included an analysis of normative documents from the International Swimming Federation (World Aquatics).

The expert criteria method was applied through the Delphi methodology to assess opinions on the proposed conception and determine its validity for application in the technical preparation process of the figures. A total of 15 experts were selected. The established sequence according to (Hurtado de Mendoza, 2020) was as follows:

1. Contact was established with knowledgeable experts and they were asked to participate in the panel.
2. A questionnaire was sent to panel members and they provided their opinions on the topics of interest.
3. Responses were analyzed, and areas of agreement and disagreement were identified.
4. A summarized analysis of all responses was sent back to panel members for them to fill out the questionnaire again and provide their reasoning regarding opinions where there was no consensus.
5. The process was repeated until the responses were consolidated.

In processing the results, descriptive statistical methods such as mean, mode, and standard deviation were applied, which are measures of central tendency and dispersion. These described how values move, converge, or diverge around the mean. As for inferential statistics, the Kendall's W Test was used to determine the level of significance.

RESULTS AND DISCUSSION

Evaluation of the results using the expert criteria method with the Delphi methodology

A. Selection of Experts



Fifteen experts were selected who had a direct relationship, either with sports training or specifically in artistic swimming training. For their selection as experts, the following aspects were considered:

- Professional experience related to the research topic.
- Years of professional experience as an artistic swimming coach.
- Research conducted in some way related to the topic under consideration.
- Impartiality or low level of commitment to the researcher.
- Willingness to participate in the research.
- Scientific degree.
- Teaching category.

B. Determination of the Competence Coefficient (k) and Selection of Experts

The experts' competence was determined by the coefficient K, which was calculated based on the candidate's opinion of their level of knowledge or information about the problem under investigation and the sources that allow them to argue their criteria. The K coefficient is calculated as $K = \frac{1}{2} (Kc + Ka)$, where Kc represents the knowledge coefficient and Ka represents the argumentation coefficient.

To obtain the knowledge coefficient for each expert (Table 1), the rating given by each expert on a scale of zero to ten regarding their knowledge of the subject is multiplied by 0.1 (divided by 10). Thus:

- A rating of 0 indicates absolute lack of knowledge of the issue being evaluated.
- A rating of 1 indicates full knowledge of the aforementioned issue.

Table 1. - The coefficient of knowledge or information is summarized

Knowledge or information coefficient (Kc)	0,7	0,8	0,9	1
Number of individuals	2	3	3	1



The questionnaire applied to determine the level of competence of potential experts and the analysis of the competence coefficient allowed the selection of nine individuals meeting this condition; seven with a high competence coefficient and two with a medium coefficient with an average value of 0.85. This assessment takes into consideration:

- $-1 \leq K_c \leq 0.9$ high knowledge coefficient.
- $-0.8 \leq K_c \leq 0.6$ medium knowledge coefficient.
- $-0.5 \leq K_c \leq 0$ low knowledge coefficient.

In this regard, it is found that five experts have a high K_c (50 %), while four have a medium K_c (50 %). Next, the value of the argumentation coefficient (K_a) for each expert is obtained, which is calculated based on the information provided by each expert in the standard table presented to them without figures. They were instructed to mark with an X which sources they considered had influenced their knowledge, according to high, medium, and low degrees. A standard table (Table 2) was used for this purpose.

Table 2. - Standard for calculating the argumentation or foundation coefficient of the experts

SOURCES OF ARGUMENTATION	Degree of influence of each source on their criteria		
	A (High)	M (Medium)	B (Low)
Theoretical analyses	0,3	0,2	0,1
Scientific experience	0,5	0,4	0,2
Works by national authors	0,05	0,05	0,05
Works by foreign authors	0,05	0,05	0,05
Knowledge of current state of the problem abroad	0,05	0,05	0,05
Intuition	0,05	0,05	0,05
Total	1	0.8	0.5

From these results, it was inferred that out of the respondents, seven have a high K_a (77.7 %) and two have medium K_a (22.2 %). The level of competence of potential experts was determined based on the knowledge coefficient (k_c) and argumentation coefficient (k_a). Now, if:

- $-0.8 \leq K \leq 1 \Rightarrow$ high competence.



- $-0.5 \leq K < 0.8 \Rightarrow$ -medium competence.
- $-0 \leq K < 0.5 \Rightarrow$ low competence.

To determine the competence coefficient K , based on the integration of the previous results, the following formula was applied. Equation 1:

$$K = \frac{1}{2} (K_a + K_c) \quad (1)$$

Results of the level of competence of potential experts based on the knowledge coefficient (k_c) and argumentation coefficient (k_a) (Table 3).

Table 3. - Results of the level of competence of potential experts based on the knowledge coefficient (k_c) and argumentation coefficient (k_a)

Experts	Kc	Ka	K	Competence Level	Acceptance for Interview
1	1	0,7	0,85	High	Yes
2	0,9	0,8	0,85	High	Yes
3	0,9	0,8	0,85	High	Yes
4	0,7	0,8	0,75	Medium	Yes
5	0,7	0,7	0,70	Medium	Yes
6	1	0,9	0,95	High	Yes
7	0,8	0,8	0,80	High	Yes
8	0,8	0,9	0,85	High	Yes
9	0,9	0,9	0,90	High	Yes

As a result of applying this procedure, it was found that seven of the survey respondents have a high level of competence (77.7 %) and two have medium competence (22.2%). The experts were selected by using the criterion of experts who have achieved high and medium levels of competence. In this case, nine out of the possible 15 were selected, which accounted for 60 % of the surveyed individuals.

Out of the nine experts: one holds a Ph.D. in Physical Culture Sciences with a full professor teaching category, two are specialists, and six are Bachelor's degree holders in Physical Culture. The average work experience is 23 +/- 5 years, with a minimum of 17 and a maximum of 30. Eight are artistic swimming coaches, and one holds the position



of national technical chief. Once the experts were determined, to provide criteria and value judgments on the designed concept, a copy of the theoretical conception was sent to them. The aim was to assess their evaluative criteria regarding the feasibility of the contributions made in the research.

In that regard, this process was carried out through two rounds that enabled them to provide their criteria and evaluations regarding the concept. Following the first round, as a result of the suggestions made by the experts, it was necessary to restructure some aspects of sports planning, as well as to evaluate and consider other elements that had not been taken into account up to that point. Additionally, the survey itself underwent modifications, as several questions were included in the first round, and the possibility of providing other aspects that should be part of the conception was suggested. Some of the most frequent elements that allowed for its improvement were:

- The planning and distribution of loads in figures training is suggested to also be expressed in repetitions.
- Include stability for figures control.

After the correction of the previous elements, the second round is conducted, and the evaluative results derived from the method application are processed. The experts were presented with the results of the processing of the first survey applied, and the differences of opinion among them were analyzed. Subsequently, the refined proposal based on the recommendations and suggestions given was presented for their consideration.

Analysis of information and statistical processing

The result of the statistical processing is shown after the second round, using Microsoft Office Excel 2010 software (Table 4).



Table 4. - Result of descriptive statistical processing

		Statistics						
		Expe rts	Relation ship establi shed between the subsys tems of the theoretic al concepti on	Express function ality in a logical order	Criteri a for evaluat ing technic al actions and figures	Applicab ility of categor ies, dos ing and distributi on of load, content, method, and control	Quality and precision of guidelines for methodolo gical treatment	Theoretic al conceptio n contribut es to the improve ment of the figure training process in school artistic swimmer s
N	Valid cases	9	9	9	9	9	9	9
	Missing cases	0	0	0	0	0	0	0
	Mean		4,56	5,44	5,44	5,44	5,44	5,44
	Median		5,00	6,00	6,00	6,00	6,00	6,00
	Mode		5	6	6	6	6	6
	Std. Deviation		,527	,726	,726	,726	,726	,726
	Minimum		4	4	4	4	4	4
	Maximum		5	6	6	6	6	6

Furthermore, it is summarized in (Figure 1) that the data is rated as good. Likewise, the median and mode are grouped in the assessment of very good, with a tendency to be rated as excellent.

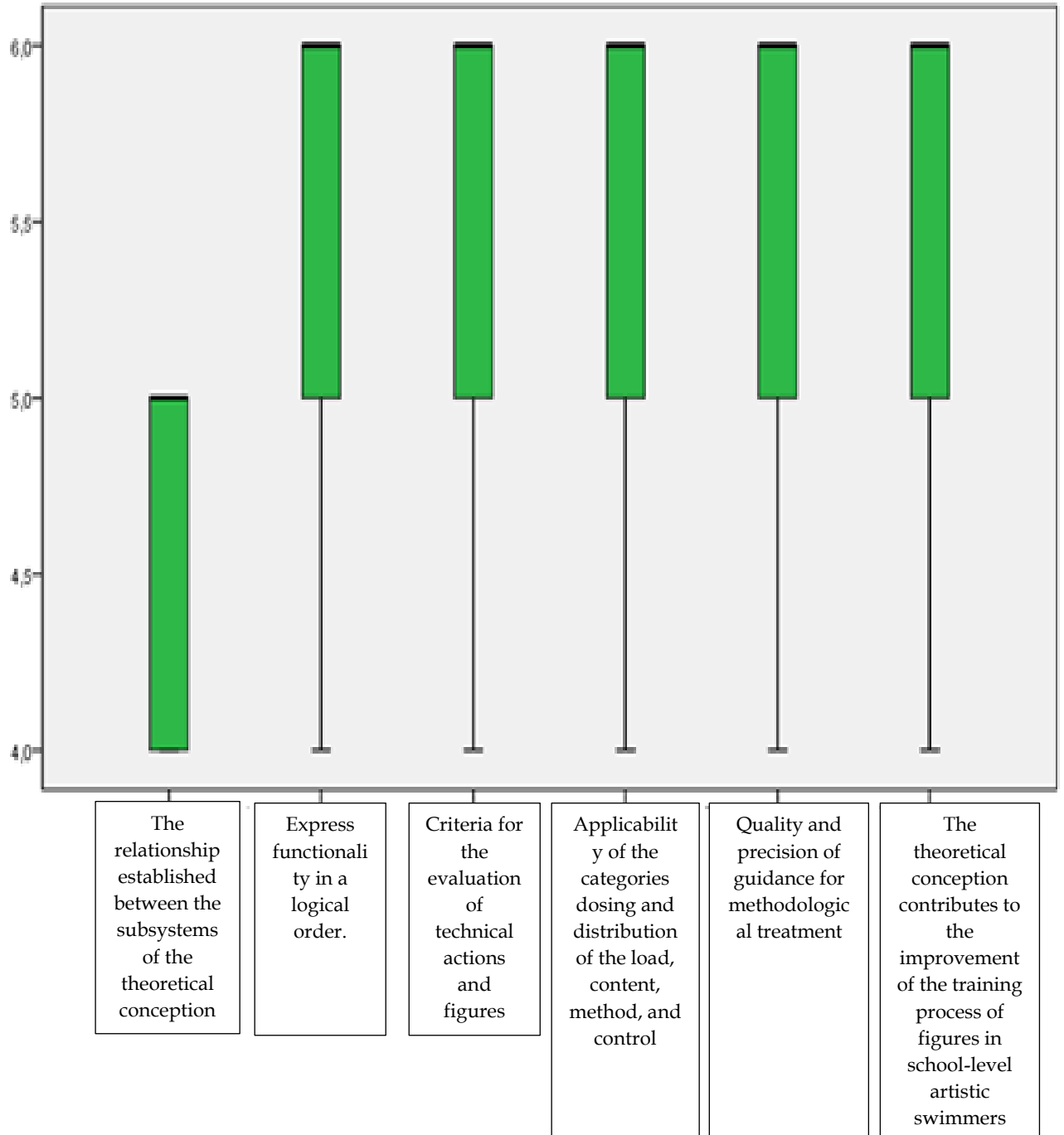


Fig. 1. - - Descriptive statistical results of expert evaluation, according to the Delphi methodology



Kendall's W Concordance Coefficient Test

The non-parametric Kendall's W test was applied to the data of the experts. The statistical package SPSS 19 for Windows was used. The results are shown in (Table 5).

In carrying out the significance test of W, the following hypotheses were considered:

- Null hypothesis (H₀), the statement that there is no agreement among the experts.
- Alternative hypothesis (H_A), the statement that there is agreement among the experts.

That is: H₀: W=0, H_A: W≠0.

The significance level (α) was set at 0.05

Table 5.- Contrast Statistics

Contrast Statistics	
N	9
Kendall's W	,592
Chi-square	26,653
df	5
Asymp. Sig	,000
a. Kendall's concordance coefficient	

As observed, Kendall's concordance coefficient indicates agreement among the expert evaluations. With a value (W) of 0.59, as $P(H_0) < \alpha$, where α : significance level of 0.05, indicating a 5% error, the null hypothesis H₀ is rejected, meaning the alternative hypothesis H_A is accepted.

In other words, based on the obtained result, the null hypothesis H₀ that the expert estimates were not in agreement is rejected, and the alternative hypothesis H_A is accepted. The agreement among the experts regarding the presented proposal (theoretical conception) means that the majority of them assess the six aspects positively



with a 95 percent level of reliability. In other words, there is sufficient empirical evidence confirming the agreement in judgments issued by the experts.

Next, the specific theoretical conception in question (Figure 2) is presented, revealing the peculiarities of training figures in school artistic swimmers. The distinctive features are:

- The systemic nature of the conception, developed within the dynamic context of compulsory and optional figures, where the relationships of the subsystems are established based on the specificities of artistic swimming. The conception presents definitions, laws, and principles to ideally explain the training of figures in school-level artistic swimmers.
- The dynamic nature is distinguished by the wide range of variations and transformations in the training of compulsory and optional figures in artistic swimmers. It is characterized by the relationships between laws and principles for adapting training loads and restructuring training in the design and control of technical skills: straight ballet leg, barracuda, walkover back, ballerina, kip, swordfish, seagull, and water drop; which enable the refinement of figures for enhanced sports performance.

The aim is to enhance figure training through improving technical preparation in school-level artistic swimmers. The conception offers a schematic representation, ideal for figures training, establishing links and relationships between the subsystem theories that underpins this process.

The unique aspect of the theoretical conception is the new dynamics established, from the training periodization of figures to the restructuring of content. It involves the proper use of specific exercises based on factors tailored for the design and control of figures in school-level artistic swimmers, previously not considered. This highlights the epistemological, methodological, and practical particularity.



The designed conception has an open nature, allowing for further investigation. Human resources (coaches and artistic swimmers) are identified as input elements to diagnose the level of knowledge and technical skills of the artistic swimmers and the technical knowledge of the coaches to address the process. It is structured by the periodization and restructuring subsystems of figure training, establishing essential coordination relationships, underlying a holistic conception of functioning as an integral whole. Thus, new qualities are revealed that allow for the approach and interpretation of technical training. Therefore, the modeled process is logical and coherent.

One of the coaches' major challenges is facilitating the transformations demanded by historical changes in sports. They must respond to scientific knowledge evident in contributions from philosophy, pedagogy, psychology, physiology, and didactics in sports technical preparation to enhance the improvement of figures training in school-level artistic swimmers. Elements considered lead to the dynamic balance of the system to achieve the goal, demonstrating the system's homeostasis.

External influences focus on the physical, theoretical, and psychological aspects. Its internal structure, determined by the periodization and restructuring subsystem of figures, in its design and control, shows essential coordination and cooperation relationships. Within, its components are identified, characterized by their subordination to each subsystem; elements that typify the recursiveness and synergy of the conception. As an essential manifestation of autopoiesis, the self-development of figure training from the technical behavior of artistic swimmers is identified, expressing increased athletic performance with new emerging characteristics.

A necessary condition for developing the conception is to define the concepts and categories involved in this process. In this regard, concepts proposed by the research authors are of importance, such as:

- Figure training in artistic swimmers: encompasses all didactic means used to systematically learn and refine figure techniques and to accumulate optimal experiences in situations specific to artistic swimming.



- Ballet leg figure: a technical skill in artistic swimming established by FINA and classified as simple, alternate, simple, underwater, double, double underwater, and straight.
- Fundamental categories that distinguish the conception:
- Figures: technical skills subjected to training essential for competitive activity, including the combination of basic positions and/or movements established by FINA (2022).
- Control: refers to the stability of technical movement.

The proposed periodization subsystem reveals biological laws applied to sports training for the biological adaptation of artistic swimmers to training loads. This adaptation is achieved through the so-called training principles, reflecting basic regularities in the form of practical orientation axioms.

The figure restructuring subsystem, with specific factors for its design and control, is substantiated by these laws and principles being guiding axes of practice, allowing for the distribution of volume and intensity in figure training planning. Additionally, it involves the application of more effective means and methods as a developmental process in response to adaptation reactions.

In terms of figure restructuring quality, it considers aspects evaluated in their execution: design and control, unveiling specific accuracy factors in the design (accuracy in positions and transitions of different parts of the figure) and specific control factors (sustained height, movement uniformity, and stability) to be considered in the development of special exercises for enhancing figures in artistic swimmers. This results in a higher-order character that designates the process as reflective-evaluative.

Artistic swimmers must reflect or imitate the accuracy of each basic movement or transition of the figures based on their cognitive ability to reflect reality and information provided in training. However, transformations in the execution of movements or figure transitions may occur while reflecting reality, leading to the cultivation of correct posture in each design, even when each swimmer adopts their style. The evaluative



aspect corresponds to the guidance and assessment of technical executions, taking into account body sensations in the water, sustained body part height, and control of each movement performed.

The distinctive reflective-evaluative character in artistic swimmers is not only reflected by observing real phenomena but also offers a particular assessment based on their ideal, conception, and value system for technical execution of varying difficulty levels, giving rise to evaluative aspects. In other words, it is not merely technical imitation or fixation; it is also evaluated from the perspective of specific fixations, transformations, and the ideal, allowing for the qualitative motor traits of accuracy and control in the motor sequence of figures to emerge (Figure 2).

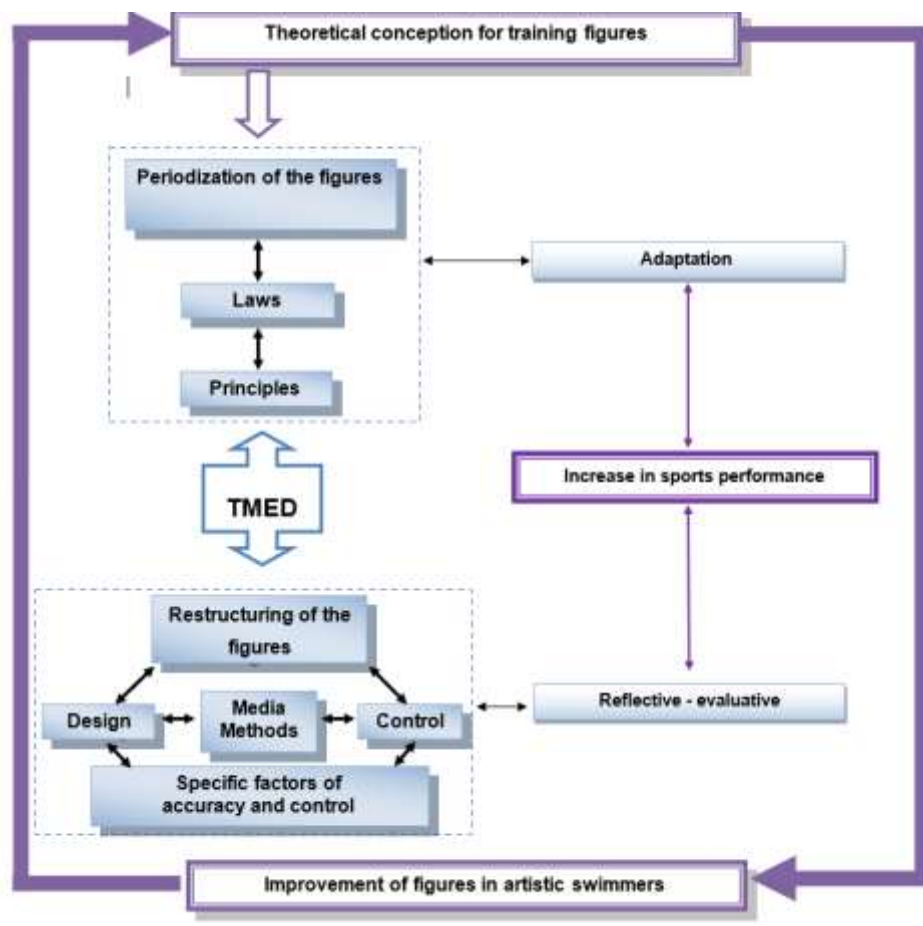


Fig. 2. - Graphical representation of the theoretical conception developed for figure training in school-level artistic swimmers



The theoretical conception ensured a logical functional process for figure training, allowing for the establishment of a theory for training planning and application. It assumed elements proposed by (Capote *et al.*, 2017; Brito, 2020; FINA, 2021; FINA, 2022; Rodríguez *et al.*, 2022; Hernández *et al.*, 2023, and Hernández *et al.*, 2023), such as means (flutter and floatation exercises) and methods for the design and control of the figures.

On the other hand, other authors (Escrivá & González, 2020; Li *et al.*, 2020; Podrihalo *et al.*, 2021; Ponciano *et al.*, 2021, and Fons & Ruiz, 2021) highlight the difficulty of technical actions in the arrangement and design of a set of movements, as well as in the impact of strength on performance. These contributions are significant but do not encompass the theories and contents for figure training, revealing the challenges in skills, particularly in technical virtuosity.

This study concludes that the results of the evaluation by experts on the designed conception are statistically significant. The nine experts agree on its relevance, structure, and functionality, as well as its effectiveness in enhancing the process of figure training in artistic swimmers.

CONCLUSIONS

The proposed concept starts from the interrelation of its subsystems, as well as the relationship between them, with a direct focus on the reorganization of training for the athletes, complying with the fundamental laws and principles from the theory and methodology of sports training, as the theoretical core.

The scientific assessment carried out by the consulted experts confirmed the scientific value of the concept, through the evaluation of excellent and very good ratings of the indicators that highlight its theoretical-methodological coherence and applicability.



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Conflict of interest:

The authors declare no conflict of interest.

Authors' contribution:

Liudmila Hernández Soutelo: conception of the idea, search and review of literature, preparation of instruments, application of instruments, compilation of information resulting from the applied instruments, correction of the article, authorship coordinator, review of the application of the bibliographic standard applied.

Erva Brito Vázquez: preparation of instruments, statistical analysis, preparation of tables, graphs and images, general advice on the topic addressed, writing of the original (first version), Review and final version of the article, correction of the article, translation of terms or information obtained

Noelis Durades Manzano: review and final version of the article, correction of the article, translation of terms or information obtained.



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