The Scientific Impact of Applied Biomechanics Research in Artistic Gymnastics

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Abstract: The paper investigates the scientific impact of applied biomechanics research in artistic gymnastics. Therefore, biomechanics studies conducted from 2012 to 2014 and published so far were analysed. The learning macro-methods (M-ML) of gymnasts in basic specialization training stage (EPSB) were scientifically argued and practically applied. The biomechanics structure used video-computerized method and postural landmarks method, which identified, measured and analysed the technique key elements in vaults, uneven bars, balance beam and floor. The study results highlighted improved kinematic and dynamic parameters of the key elements of the analysed exercises technique by efficient use of M-ML in training. The analysis of the specialized literature compared with the performed studies reveals the research interest, citations, recommendations and reads. The scientific acknowledgment of publications in ResearchGate academic profile proves the efficiency of methodology application in preparation, which can serve as training method in gymnastics branches and related sports fields as well.

Keywords: *Citations, Macro-methods learning, Recommendations, Research interest, ResearchGate, Reads*

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1. Introduction

Artistic gymnastics is one of the oldest Olympic sports events. The basic tool for gymnastics development was and still is the competition rules of the Gymnastics International Federation (FIG). The changes in the Code of Points highlight the evolution and the trends to improve the competition apparatus. Among the main specific trends are the increase of the competitive programs' difficulty and the higher quality of execution mastery (Arkaev & Suchilin, 2004).

Since the laws of learning the gymnastics exercises are closely related to the laws of mechanics, the knowledge of these laws is necessary for both athletes and coaches in order to understand the main mechanisms that belong to the execution technical basis and to the training methods (Arkaev & Suchilin, 2004; Gaverdovskij, 2007).

The discipline that studies the human body movement is the Kinesiology and the biomechanics is one of the many academic sub-disciplines of kinesiology (Knudson, 2007). Biomechanics is most useful for improving the performance in sports or activities where technique is the dominant factor rather than physical structure or physiological capacity (Rowbottom, & Alexander 2012). Researches in biomechanics field regarding the sports technique tend sometimes to remain behind the changes that occur naturally in sports. Athletes and coaches' experiment with new techniques all the time (Knudson & Morrison, 2002).

Numerous biomechanics studies and researches are scientifically applied in artistic gymnastics to understand and classify movements, for identifying the most important characteristics of the competition events and exercises (Prassas et al., 2006). However, there is no sufficient information on the biomechanics research applied in training by the implementation of didactical methodologies (Potop, 2015).

The purpose of this study was to investigate the scientific impact of the biomechanics researches applied in artistic gymnastics.

Hypothesis of the paper. We consider that the analysis of the specialized literature in comparison with the weight of the applied biomechanics studies will highlight the scientific impact and the efficiency of using the training methodology during preparation.

2. Material and Methods

2.1 Subjects

The study included female gymnasts of 12 to 17 years old, members of the Romanian national team in the period 2012-2014, corresponding to the classification categories juniors 2 and 1, some of them even seniors, participating in 7 official national competitions.

2.2. Design and procedure of the study

The macro-methods of learning (M-ML) of the female gymnasts during the basic specialization training stage (EPSB) were used for improving the key elements of the technique during the training (Potop, 2015). Structurally, M-ML as a dynamic system implies the functional unity of the long-term programs for learning the exercises of vaults, uneven bars, balance beam and floor. The study of the exercise's technique was carried out using the computerized video method and the postural orientation method (Boloban, 2013).

The research results were published between 2012 and 2020, in specialized journals and proceedings with indexation in international databases (BDI). They can be viewed in several academic and research profiles (ORCID; Google academic, ResearchGate (RG), Scopus, Elsevier, Science Direct, Mendeley, Publons).

In order to show the scientific impact of the research, the publications with biomechanics content in artistic gymnastics in the period 2012 - present moment were selected from the RG profile. The general status of the scientific value is presented (Potop, n.d.). Each published study was analyzed in the ResearchGate profile according to the indicators: *research interest, citations, recommendations, reads*.

2.3. Statistical Analysis

Statistical data processing was made using KyPlot 5.0 program (1997-2017, KyensLab Inc.), calculating the descriptive data: mean, error of standard mean, SD – standard deviation; sum.

The weight of the scientific impact of the applied biomechanics research in artistic gymnastics was calculated by the ratio of the values of Stats overview indicators at Articles and Conference papers indicators.

The correlative analysis between the values of the scientific interest indicators and the total reads in the publications in journals and conferences was made using the Pearson's linear parametric method.

3. Results

The scientific value of stats overview in ResearchGate of 12.08, h-index = 4 (without self-citations), total research interest (TRI) = 107.3, total Citations (Cit.) = 79.0, Recommendations (Rec.) = 41.0, Total reads (TR) = 5364, Full-text reads = 1687 and Other reads = 367.

The research analyzed a number of 31 publications available full-text in the RG (n=10, article and n=21 – conference paper) from 2012 till the present moment.

Table no 1. *Scientific value of publications in RG (n=31) Source: Authors' own conception*

Descripti ve data	RI	Cit.	Rec.	Reads						
				TR	RG M	N- M	RGM		N-M	
							Full - text	Othe r	Full- text	Othe r
Mean	1.91	1.71	0.42	97.8 4	13.5 5	84.2 9	5.6 1	7.93	26.5 2	57.7 7
SEM	0.31	0.45	0.11	19.9 3	2.22	18.0 9	0.9 1	1.40	6.94	11.9
Sum	59.4	53	13	303 3	420	261 3	174	246	822	1791
PS (%)	55.3 6	67.0 9	31.7 1	56.5 4	24.8 9	71.0 6	-	-	-	-

Note: SEM – standard errors mean; SD – standard deviation; PS – scientific weight; RI – research interest; TR – total reads; RGM – ResearchGate members; N-M – non-members;

The scientific impact of the applied biomechanics research had a value of the RI of 55.36 % and 59.4 points, Cit.–67.09 % and 53 citations, Rec. – 31.71 % and 13 recommendations. Total reads – 56.54 % and 3033 of total reads, Reads RGM –24.89 % and 420 TR, Reads N-M – 71.06 % and 2613 reads TR. Reads full-text RGM – 174 reads and Other – 246 reads. Reads full-text at N-M – 822 reads and Other – 1791 reads.

The results of the correlative analysis highlighted strong connections at article $R = 0.89$ ($p = 0.003$) and a poor connection $R = 0.29$ ($p = 0.201$) at conference paper. It has been observed that the scientific value of the research interest is not closely related to the total reads, because N-M had a higher value in the view of the publications.

4. Discussions

The improvement of the technique key elements during preparation was achieved by using the macro-methods of learning (M-ML) (Potop, 2015) with long-term programs as structural element. The biomechanics research used the computerized video method and the postural orientation method (Boloban, 2013).

Sometimes the concerns of the specialists in biomechanics research field regarding sports techniques tend to stay behind the changes that naturally occur in sport (Knudson and Morrison, 2002). There was also made an analysis of the research trend in artistic gymnastics concerning the sports biomechanics, classified according to research methods, areas, and main topics (Han & Kwon, 2007).

The research was conducted on the basis of the information available in the RG, divided into two categories of publications (research): article and conference paper. The scientific impact on the applied biomechanics research in artistic gymnastics was highlighted by analyzing the indicators of the RG. The ratio between the RG indicators and their total value reveals the impact and the value of the scientific acknowledgment in the field.

Many studies were carried out and published throughout this period; they can be viewed in several BDI and scientific or academic profiles. There are also presented some citations that justify the methodology and technologies applied in the biomechanics studies (Diener-González, 2019; Aleksić-Veljković et al., 2019).

5. Conclusions

The current orientations in the implementation of the biomechanics research and the manifested scientific impact are presented by means of the interdisciplinary approach: modern didactical technologies are used in the training and the competition performances are turned into profit.

Performing the analysis of the specialized literature compared with the weight of the biomechanics studies applied in artistic gymnastics emphasized the scientific impact and the efficiency of using the training methodology during preparation.

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