Impact of the control and planning system of the training process on the development of the technical skills of female gymnasts aged 12 to 15 years

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Abstract
Purpose: highlighting the impact of the control and planning system of the training process on the development of technical skills complex of the female gymnasts aged 12 to 15 years.
Material: the experimental study was conducted from 2013 to 2016, with two research groups (experimental, n=10 and control, n=10), in „Speranja” Sports Club of Chisinau. Test events in handspring vaults, uneven bars, balance beam and floor were used to assess the technical training level.
Results: they reveal the technical skills of the 12 to 15 years old female gymnasts in handspring vaults, uneven bars, balance beam and free exercises on the floor with regard to the performances achieved in the annual training macrocycles 1, 2, 3 and 4 within the Olympic cycle 2013-2016. The results highlight also the differences of the averages within macrocycles and investigation groups and between macrocycles and groups at P<0.05, 0.01 and 0.001.Conclusions: The motor behavior of the gymnasts was influenced by the concrete objectives, the strategy and content of the research program and the specific forms of control and monitoring as important component elements of sports training. The experimental model program was a fundamental instructional model of development, maintaining and modification of the training system throughout all training periods, including the competitive and transition periods of the Olympic cycle.

Key words: artistic gymnastics, control, technical training, planning, performance.

Introduction
Artistic gymnastics has currently registered remarkable progress, proving that it develops in accordance with the performance sport but it also has its specific important features, such as (Arkaev & Suchilin, 2004): increase of sports mastery, improvement of the components that ensure the training of elite female gymnasts.

Learning the technique of various sports branches is generally characterized by the laws and stages of learning the motor actions and acts, of course with some specific and differential features determined by the particulars of sport branches (Dragnea, Mateh Teodorescu, 2002, p.281). Efficient learning, in different stages of technical training, can be ensured only if the stages and content of learning are closely related to efficiency criteria (Platonov, 2004, p.301).

Currently, the number of technical elements created by the elite male and female champions increased considerably due to the impressive dynamics of gymnastics competition. Some of these elements took the coded names that reflect their biomechanical characteristics, besides the names of the athletes who executed them with unique virtuosity (Endo, Drăgulescu, Miloşevici, Comăneci, Şuşunova etc.) (Nicu, 1993, p.258).

The technique of gymnastics exercises, depending on the biomechanical positions, is analyzed in conformity with the "arithmetical" entry, which involves operations of improvement of the concrete issues (Smolevskij & Gaverdovskij, 1999; Gaverdovskij, 2007). In gymnastics, the role played by the technical training is very important and in close interdependence with the other components; thus, a poor physical training of the children leads to a bad, wrong technique, therefore to lack of success in competition. Also, a good technical training based on a good physical training, but in the absence of an adequate mental training results in poor performances (Grigore, 2001; Potop, 2013).

The specific technical skills are expressed by gymnasts’ relatively stable complexes of skills, capacities and aptitudes which condition the successful achievement of different artistic and technical compositions on gymnastics apparatus, performed with elegance, plasticity, accuracy, qualitative and quantitative efficiency and low consumption of energy (Buftea, 2013). In order to enable a young gymnast to successfully execute the technical elements of higher difficulty in the future, the coach / teacher should pay attention to the long-term syllabus too and should work according to the scheme: “when learning the technical elements, one should go from the main purpose to the concrete situation and back to the main purpose”, keeping under control the whole learning process, based on the perspective (Boloban, 2011; Potop, 2015). Gymnastics has made great technical progresses but also performance progresses due to the improvement over time and to better functional parameters of competition apparatus. Coaches must always focus on imagining and creating means, apparatus and technologies intended to help athletes during workouts and to protect them at the same time, making easier the effort of learning and self-improving (Vieru, 1997; Gaverdovskij, 2002).
The control and assessment of training is a binding requirement for each coach and also an important factor in checking the validity of the developed program and making the necessary corrections. The assessment of training is based on control and analysis which are an element of dynamization of the training process and a condition of progress as well (Rozin, 1997; Vieru, 1997; Grimalschi, 2015).

The establishment of precise and even individualized tests and norms to be reached both physically and technically during a certain period is a pedagogical requirement with stimulator effect on the training and setting of the intermediate goals leading to the completion of the annual training plan (Bufftea, 2016).

The purpose of the paper is to highlight the impact of the control and planning system of the training process on the development of technical skills complex of the female gymnasts aged 12 to 15 years.

Hypothesis of the paper: we consider that the implementation of the control and planning system in the training process of the female gymnasts aged 12-15 years will contribute to the improvement of technical training level and to the achievement of better performances in competitions.

Material and methods
The following methods were used in this research: bibliographic study on the theoretical-conceptual, methodological and practical essentials presented in the specialized scientific-methodical literature; study of documentary materials; pedagogical observation; method of specific tests; pedagogical experiment; statistical mathematical method and data graphical representation method. The experimental study was conducted during the period 2013-2016 with two research groups (experimental, n=10 and control, n=10) within the Sports Club “Speranta” of Chisinau. Specific tests for each apparatus of the competitive polyathlon were created in order to determine the effectiveness of the control and planning system of the training process for developing the technical skills of the gymnasts-subject of the research. One organized and carried out measurements in terms of assimilation and improvement of execution technique of the separate elements and the connections of elements in: handspring vaults, uneven bars, balance beam and free exercises on the floor. 

Handspring vaults (HS):
HS1 – handspring vault with 180º turn without salto (1st and 2nd year of the 4 year cycle).
HS2 – Tsukahara with salto backward layout (3rd and 4th year of the 4 year cycle).

Uneven bars (UB):
UB 1 (high bar) – mount with extended body to handstand, free circle to handstand, back giant and dismount through layout salto with landing (for the 1st and 2nd year of the 4 year cycle).
UB 2 (low bar) - mount with extended body to handstand, passing to high bar by sub-swing, straightening, three back giants with acceleration, dismount by double salto pike (for the 3rd and 4th year of the 4 year cycle).

Balance beam (BB):
BB1 – side turn over (cartwheel), round-off, dismount by back salto tucked (1st and 2nd year of the 4 year cycle).
BB2 – mount by forward salto, dismount by round-off, double back salto tucked (for the 3rd and 4th year of the 4 year training cycle).

Free exercises on the floor:
FE1- round-off, flick-flack backward, somersault backward layout (1st and 2nd year of the 4 year cycle);
FE2- walkover forward somersault forward tucked connected, round-off, flick-flack, somersault backward extended with 360º turn (for the 3rd and 4th year of the 4 year cycle).

Results
Table 1 and figures 1, 2, 3, and 4 show the results of the technical training of the gymnasts aged 12-15 years in handspring vaults, uneven bars, balance beam and free exercises on the floor regarding the performances achieved in the annual macro-cycles of training 1, 2, 3 and 4 of the Olympic cycle 2013-2016. They also show the differences of the averages within macro-cycles and investigation groups and between macro-cycles and groups.

<table>
<thead>
<tr>
<th>Training macro-cycles</th>
<th>Experimental group (n=10)</th>
<th>Control group (n=10)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro-cycle 1 (points)</td>
<td>8.67 ± 0.04</td>
<td>8.60 ± 0.07</td>
<td>0.87</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Macro-cycle 2 (points)</td>
<td>9.62±0.05</td>
<td>8.87±0.26</td>
<td>2.83</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>t, P (1 and 2)</td>
<td>2.78; &lt; 0.05</td>
<td>0.45; &gt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Macro-cycle 3 (points)</td>
<td>11.25±0.33</td>
<td>9.30±0.13</td>
<td>5.49</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>t, P (2 and 3)</td>
<td>2.71; &lt; 0.05</td>
<td>0.45; &gt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Macro-cycle 4 (points)</td>
<td>13.05±0.27</td>
<td>11.25±0.26</td>
<td>4.8</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>t, P (3 and 4)</td>
<td>2.24; &lt; 0.05</td>
<td>2.95; &lt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: df=9; t=2.262; 3.250;4.781; df= 20-2, P < 0.05; 0.01; 0.001. P<0.05; 0.01; 0.001. r=0.662; t=2.101; 2.878; 3.922.
Fig. 1. Dynamics of technical skills results of the gymnasts aged 12-15 years in handspring vaults

Table 2. Comparative analysis of the technical training of gymnasts aged 12-15 years on uneven bars

<table>
<thead>
<tr>
<th>Training macro-cycles</th>
<th>Experimental group (n=10)</th>
<th>Control group (n=10)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro-cycle 1 (points)</td>
<td>9.15±0.04</td>
<td>9.19±0.06</td>
<td>0.55</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Macro-cycle 2 (points)</td>
<td>9.79±0.09</td>
<td>9.28±0.11</td>
<td>1.52</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>t, P (1 and 2)</td>
<td>1.4; &gt; 0.05</td>
<td>0.19; &gt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Macro-cycle 3 (points)</td>
<td>10.64±0.18</td>
<td>9.77±0.05</td>
<td>3.66</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>t, P (2 and 3)</td>
<td>1.5; &gt; 0.05</td>
<td>0.43; &gt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Macro-cycle 4 (points)</td>
<td>13.81±0.25</td>
<td>11.17±0.35</td>
<td>3.94</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>t, P (3 and 4)</td>
<td>3.16; &lt; 0.01</td>
<td>2.89; &lt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: table 1.

Fig. 2. Dynamics of technical skills results of the gymnasts aged 12-15 years on uneven bars

Table 3. Comparative analysis of the technical training of gymnasts aged 12-15 years on balance beam (x±m)

<table>
<thead>
<tr>
<th>Training macro-cycles</th>
<th>Experimental group (n=10)</th>
<th>Control group (n=10)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro-cycle 1 (points)</td>
<td>9.57±0.08</td>
<td>9.60±0.05</td>
<td>0.32</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Macro-cycle 2 (points)</td>
<td>9.81±0.05</td>
<td>9.78±0.04</td>
<td>0.5</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>t, P (1 and 2)</td>
<td>0.59; &gt; 0.05</td>
<td>0.18; &gt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Macro-cycle 3 (points)</td>
<td>12.37±0.30</td>
<td>10.32±0.28</td>
<td>3.36</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>t, P (2 and 3)</td>
<td>3.8; &lt; 0.01</td>
<td>0.91; &gt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Macro-cycle 4 (points)</td>
<td>13.98±0.39</td>
<td>11.54±0.40</td>
<td>4.36</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>t, P (3 and 4)</td>
<td>3.27; &lt; 0.01</td>
<td>2.34; &lt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: table 1.
Fig. 3. Dynamics of technical skills results of the gymnasts aged 12-15 years on balance beam

Table 4. Comparative analysis of the technical training of gymnasts aged 12-15 years on the floor (x±m)

<table>
<thead>
<tr>
<th>Training macro-cycles</th>
<th>Experimental group (n=10)</th>
<th>Control group (n=10)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro-cycle 1 (points)</td>
<td>8.99±0.05</td>
<td>9.03±0.06</td>
<td>0.51</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Macro-cycle 2 (points)</td>
<td>9.41±0.07</td>
<td>9.13±0.07</td>
<td>0.83</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>t, P (1 and 2)</td>
<td>0.42; &gt; 0.05</td>
<td>0.25; &gt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Macro-cycle 3 (points)</td>
<td>10.73±0.20</td>
<td>9.74±0.10</td>
<td>3.42</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>t, P (2 and 3)</td>
<td>2.35; &lt; 0.05</td>
<td>1.33; &gt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Macro-cycle 4 (points)</td>
<td>12.71±0.26</td>
<td>9.90±0.40</td>
<td>5.89</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>t, P (3 and 4)</td>
<td>3.78; &lt; 0.01</td>
<td>0.23; &gt; 0.05</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: table 1.

Discussion
The execution technique of exercises on apparatus in modern artistic gymnastics is based on preventive special training which, in our research, was marked by all types and forms of training included in our experimental program. Taking into account the interaction of these forms during gymnasts’ complex training, the technical training level and other specific demands, this study examined the technical elements that must be performed by the athlete during the official competitions according to the requirements of FIG (Arkaev & Suchilin, 2004; FIG, 2013).

Comparative analysis of the technical training of gymnasts in handspring vaults (table 1):

The analysis of the results of the technical skills test in handspring vaults over the vaulting table highlights that both examined groups obtained almost the same results in the initial testing: the average of the experimental group is 8.67 points, of the control group 8.60 points (t=0.87, P>0.05), which confirms that the groups are homogeneous, with the coefficient of variation of 1.66%.

In the subsequent testing (between macro-cycles II and III) for the technical execution of the vault by turn over and 180° turn, the gymnasts received differentiated scores: 9.62 points for the experimental group and 8.87 points for the control group (t=2.83, P<0.05). The respective means had a positive contribution to the learning and improvement of the execution technique of the second vault, more complex and more difficult – Tsukahara with back salto layout, proposed in this experiment for the macro-cycle III and IV of the Olympic cycle. Significant differences were obtained between the results of the groups examined in both macro-cycles, t=5.49, P<0.001 for the third macro-cycle and t=4.8, P<0.001 for the fourth macro-cycle.
Insignificant differences are found out in the control group in all three macro-cycles; the result of the vault was improved at the end of the experiment, obtaining 11.25 points compared to the experimental group that obtained 13.05 points. The gymnasts of the experimental group progressed significantly throughout the Olympic cycle: from 9.62 points in macro-cycle II up to 13.05 points in macro-cycle IV with the coefficients of variation 1.66%, 9.24% and 6.44%, corresponding to the second, third and fourth macro-cycles.

These differences between the statistical indicators prove the effectiveness of the experimental models applied in the training process which, guided by the correct control and planning factors of gymnasts’ training actions, contributed in a positive way to the assimilation of the execution technique of vaults elements with increased difficulty. The values of the statistical indicators show the existence of a direct relationship between the control and planning characteristics in conditioning the success of the experimental group during the Olympic cycle.

**Comparative analysis of the technical training of gymnasts on uneven bars (table 2, fig. 2):**

The technical skills on uneven bars were tested at the beginning of the Olympic cycle and then submitted to control and re-planning throughout the entire Olympic cycle.

The following values were obtained after application of the complex of technical elements to the examined groups (experimental group and control group): the experimental group and the control one obtained close values 9.15 and 9.19 points in initial testing, the calculated value of $t=0.55$ and the tabular value of Fisher (shows $P>0.05$), which confirms that the examined groups are homogeneous and have the same technical training. The statistical indicators calculated in the second micro-cycle demonstrate insignificant differences between the results obtained by the group where the experimental models were applied, compared to the control group($t=1.52, P>0.05$) where these models were not applied.

The control group did not make important progress in the technical training; the statistical indicators were insignificant throughout the Olympic cycle. Compared to the results achieved during the first macro-cycle (9.19), the control group accumulated 11.17 points at the end of the experiment, considered a sufficient progress consistent with the formed skills. The gymnasts obtained a higher score of 10.64 points in the third macro-cycle compared to the 9.79 points accumulated in the second testing. At the end of the experiment the gymnasts are evaluated with 13.81 points in comparison with the result obtained in the third macro-cycle, namely 10.64 points ($t=3.16, P<0.01$).

The comparison between the results obtained by the gymnasts of the experimental group and the results of the control group reveal significant differences in terms of technical skills both in the first test which had an easier task and in the execution of the more difficult vault: there is a significant difference of 13.81 points for the gymnasts in the experimental group and 11.17 points for the gymnasts of the control group.

The analysis of these results proves that the system of rational control and planning is effective, creating problematic situations for the gymnasts. During the third and fourth macro-cycles, the objectives aim at continuous improvement of the technical training, achievement of superior indicators of the special physical training and a psychological training in line with the competition requirements. The technical skills on uneven bars develop gradually and steadily thanks to the correct control and planning throughout the entire Olympic cycle.

The qualitative and quantitative analysis of the experiment results highlights the following matters: in the initial testing of gymnasts, the statistical indicators have an average value of 9.57 points in the experimental group and 9.60 points in the control group. The value of the arithmetical means in the experimental group increases up to 9.81 points while in the control group it increases up to 9.78 points.

In both groups examined, the first macro-cycle was not fully focused on performing exercises for the development of the back and legs muscles. Body relaxation during execution caused oscillations entailing the deviation of the centre of gravity from the limits of the supporting base; therefore the fall from this apparatus became almost inevitable. The peripheral visual field was poorly made, thus the gymnasts’ centered vision was not directed towards a specific reference point.

The study continued by applying complexes of specific actions consistent with the experimental program and included in the training process. As a result of the directed control and planning of gymnasts’ training process on balance beam, special exercises on the floor were developed for the experimental group (walkovers, somersault type elements, walkovers with turns into double salto tucked etc.) executed on a straight line previously marked, with limited displacement. Special attention was paid to arms work in order to develop a correct posture and stability in execution. In order to develop the coordination of body segments, the accuracy of execution, the proper rhythm and tempo and also the correct technical abilities and skills there were used jumps and leaps on the floor and on the balance apparatus at different heights, using also musical accompaniment.
The motor skills of the gymnasts were influenced by the concrete objectives, by the strategy and content of the research program, by the specific forms of control and monitoring as core components of the sports training.

The experimental model program was a fundamental instructional tool for developing, maintaining and modifying the training system in all periods of preparation, including the competitive and transition stages of the Olympic cycle.

These approaches provided effective results to achieve performance in the "Technical Skills" chapter and can be certainly implemented at the basis of organizing and carrying out the sports training at any stage of preparation.

At the end of the paper, we can say that the implementation of the control and planning system within the training process of the female gymnasts of 12 to 15 years old contributed to the improvement of technical training level and to the achievement of better performances in competitions which confirms the hypothesis of the research.

Conflict of interests

The authors declare that there is no conflict of interests.

References


