

IMPROVING THE QUALITY OF THE RHYTHMIC FEMALE GYMNASTS' FEET PERFORMANCE BY THE MEANS OF TRADITIONAL CHOREOGRAPHY

Olga Rumba

*Federal State Scientific Establishment «Institute of Socialization and Education» of Russian Academy of Education (FSSE ISE of RAE), Russia
Lesgaft National State University of Physical Education, Sport and Health, SPb, Russia*

Research article

Abstract

In the article we prove empirically that the feet performance quality is the significant constituent part of the sport skills in gymnastics and among the other components it has influence on gymnasts' success in competitions. Through the survey of the gymnastics specialists we determine the key-points of the female gymnasts' feet performance quality. According to the received data they are the height of rising to half toe position; the capacity to perform for a long time on one foot and maintain its turnout and the height of half toe position; the capacity to balance for a long time in high turnout half toe position; the degree of toe pointing; feet turnout. We explain the chosen check tests that let estimate the performance degree of all the indexes of the female gymnasts' feet performance quality. With determining the most effective exercises of traditional choreography we develop the methods of improving the female gymnasts' feet performance quality. The effectiveness of the developed methods is examined through the educational experiment.

Keywords: *rhythmic gymnastics, motor skills, culture of movements, quality of feet performance, traditional choreography.*

INTRODUCTION

Each sport has a number of demands that, if followed, help a sportsman to achieve high performance. For being successful in rhythmic gymnastics young female gymnasts need to develop flexibility, balance, speed, strength, endurance as well as the artistic components: beauty and elegance of movements, "postural sense", culture of movements, etc. (Karpenko, 2003). To the components of the concept of "culture of movements" many specialists in gymnastics relate quality (accuracy) of

feet's performance (Biryuk & Ovchinnikova, 1990; Savelieva, 1997; Borisenko, 2000; Karpenko, Viner & Sivitsiy, 2007; Rumba, 2013, etc).

According to gymnastics specialists the concept "feet performance quality" mainly includes the height of rising to half toe position (heels lifting), the degree of toe pointing, feet turnout (ankle joints flexibility), etc. According to Nesterova, Makarova (2009), female gymnasts' feet work can be represented as main (supporting, impacting, amortizing) and

specific (esthetic, manipulation, integral) functions that together have a great impact on female gymnasts' skill level. Figure 1.



The height of rising to half toe position

illustrates gymnastics specialists' notions about higher and lower quality of feet performance.



The degree of toe pointing

Figure 1. *The difference between the indexes of female gymnasts feet work quality*

The Code of Points indicates the significance of this sport skill aspect. Particularly according to the CoP on rhythmic gymnastics for the years 2009-2012 two panels of judges registered the quality of female gymnasts' feet work – Execution (E) jury controlling an execution (technical faults) and Artistic (A) jury controlling the artistic value of a base composition (music and choreography). Execution (E) jury penalized inaccurate feet work: for example, supporting on the heel during the part of rotation or loss of balance when performed in relevè. Artistic jury judged the general effect of female gymnasts' choreographic skills including the feet performance quality. In relation to the degree of complexity, the following penalties were applied: 0.10 point for small errors, 0.20 point for medium errors, 0.30 point and more for large errors. Final score (30.00 points maximum) was a sum of the difficulty score (Difficulty (D) jury), the artistic score (Artistic (A) jury), execution score (Execution (E) jury) – each jury's score is 10.00 points maximum.

Some changes were introduced in the new CoP for the Olympic period (2013-2016). Particularly the final score is a sum of difficulty (D) score and execution (E) score, each of which is given by different panels of judges. E-jury controls now both artistic and technical faults. However, the

score for feet performance quality remains practically the same.

Consequently, based on the opinions of the lead specialists and the CoP on rhythmic gymnastics, we can state the fact that the gymnasts' skill largely depends on the feet performance quality. Moreover, the majority of gymnastic coaches tend to enhance this aspect of work-out session with the help of traditional choreography (Botti & Nascimento, 2011). Therefore the hired choreographers are asked first of all to work with the female gymnasts' feet.

At the same time, according to Nesterova & Makarova (2009), the coaches' work on improving the functions of the female gymnasts' feet is determined not only by the aim of rising the executive skills but also by the necessity of flat-foot prevention. Often the main reasons for flat-foot are irrational feet load, lack of prevention and recovery measures, forced physical preparation and overcomplicated competition programs for junior female gymnasts. Furthermore, the majority of female gymnasts questioned by the authors said that incorrect warming-up and lack of systematic control on feet work are the main reasons for ineffective feet performance.

Summarizing the results of theoretical research, it should be admitted that interrelation between feet performance quality and the level of female gymnasts'

sport skill hasn't been confirmed empirically; this is why it still remains a widely known specialists' professional opinion. Additionally, the theory and methods of gymnastics still do not include any explicit criteria that would confirm the importance of the "feet performance quality" concept. As a result, we fail to discover scientific methods of improving the female gymnasts' feet performance quality as well as developing more effective ways of forming this sport skill aspect.

All this has led us to start working on the problem of improving female gymnasts' feet performance.

The research hypothesis: it was expected that the feet performance quality is a significant constituent part of the sport skills in gymnastics and has, among other components, influence on gymnasts' success in competitions. By exploring the key-points of female gymnasts' feet performance quality, it will be possible to select a more effective gymnastic routine in traditional choreography and to develop effective methods to improve the feet performance quality.

The research goal: to provide experiment based evidence of methods that can improve the feet performance quality as stipulated by traditional choreography.

The research tasks:

- to explore the key-points of female gymnasts' feet performance quality;
- to empirically confirm the interrelation between feet performance quality and the level of female gymnasts' sport skill;
- to develop effective methods of improving female gymnasts' feet performance quality and to test its effectiveness.

METHODS

The study was conducted in three phases:

1) The first phase comprised the survey of gymnastics coaches in order to summarize their opinions:

- on the influence of feet performance quality on female gymnasts' sport skills;

- on the key-points of female gymnasts' feet performance quality;

- on the effective methods to improve the female gymnasts' feet performance quality.

2) In the second phase we estimated empirically how the feet performance quality influences gymnasts' success in competitions.

3) The third phase included the development of effective methods that improve the female gymnasts' feet performance quality and testing their effectiveness.

In the process of the study the following methods were employed:

- survey;
- testing;
- comparison of opposite examined groups;
- educational experiment;
- methods of mathematical statistics.

Twenty five coaches from different regions of Russia were surveyed: from Moscow, St.-Petersburg, Belgorod, Vladimir, Leninogorsk, Omsk, Perm, Petrozavodsk, Pushkin, Samara, Sosnovy Bor, Tyumen, Chita and Elista. The coaches were asked three questions:

1) Does the quality of female gymnasts' feet performance influence the level of their sport skills? The test offered 5 options: "Yes, it does", "It's likely to influence", "It isn't likely to influence", "No, it doesn't", "Cannot say".

2) What are the main characteristics of estimating the female gymnasts' feet performance quality?

3) What exercises do you find the most effective in improving the female gymnasts' feet performance? The coaches asked to name the most effective exercises.

Testing comprised estimation of feet performance quality of the recruited gymnasts (n=27). It was conducted three times: at the first stage of the study during

the comparison of the opposite examined groups; at the third stage of the study during the educational experiment – before and after the experimental work out. In reference to survey answers by coaches, the following check tests were selected:

- to measure the limit angle of feet spreading in the sitting position with the hands behind (in degrees) – feet turnout was estimated (Figure 2a);

- to measure the angle between the floor and the arch of foot in half toe position (in degrees) – the height of half toe position was estimated ((Figure 2b);

- the number of rises to high half toe position from the lower rail of the wall-bar

per 30 seconds – calf muscles strength was estimated ((Figure 2c);

- the number of rises of one foot to high half toe position without touching the floor with the other foot and with no time frame – calf muscles of the one foot was estimated;

- how much time a female gymnast needs for a turnout high half toe position on one foot (the second is on passé or in attitude) – the capacity of balancing on one foot to high half toe position was estimated;

- the number of four lent rotations on one foot without touching the floor with the other foot – the strength of the pivot foot, feet turnout, balance function were estimated.

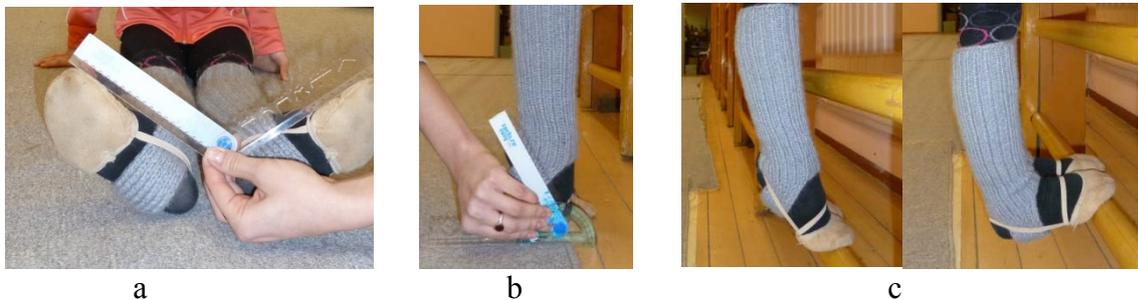


Figure 2. Feet position in different tests.

Joints flexibility was estimated by the goniometry method with the help of special compasses – *goniometer*. (Figure 3).

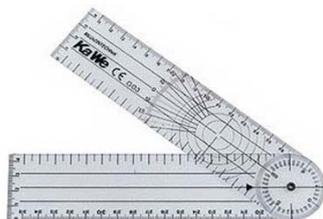


Figure 3. The tool for measuring joint flexibility – *goniometer*.

To eliminate doubt we conducted *the comparison of opposite examined groups* in two ways:

1) On the basis of performance results at the last five competitions. The points that every recruited female gymnast got at the last five competitions for the compositions were added up. In reference to the received data all recruited female gymnasts were ranged in accordance to the success rate. The first six recruited female gymnasts were put in a “strong group”, the other ones were combined into a “weak group”. Then we compared the level of quality of their performances in order to find differences.

2) On the basis of arranging results according to the pair-wise comparison method by Alexander Gorelov. All the recruited female gymnasts were compared pair-wise: the stronger female gymnast got 1 point and the weaker got zero points. For being equal each female gymnast got 0.5 point. Then the points were added up (Table 1). On the basis of these results all female gymnasts were ranked by their sport skills. On the ranking list the first six participants

made the “strong group” and the other six comprised the “weak group”. Then we compared the recruited gymnasts’ quality

level of feet performance in order to find significant differences.

Table 1. *The formula for the recruited female gymnasts ranking according to the pair-wise comparison*

	Gymnast 1	Gymnast 2	Gymnast n	Point total	Ranking place
Gymnast 1	∞	1		0		
Gymnast 2	0	∞		0		
....
Gymnast n	1	1		∞		

The *educational experiment* aimed to estimate the effectiveness of our method that helps improve the quality of female gymnasts’ feet performance with the help of traditional choreography. For the experiment we recruited 27 female gymnasts of equal qualification aged 8-10 years, attending one and the same training program with one and the same coach. The duration of the experimental period was four months, at a frequency of three lessons per week, each lesson 90 min. The parents of the female gymnasts gave written consent prior to this study. The methods were in agreement with ethical standards of the Declaration of Helsinki. Before and after the experiment we ran check tests with the female gymnasts in order to assess the feet performance quality.

The methods of mathematical statistics included the following standard measures: arithmetic mean calculation (M); standard error of the mean finding (m); confidence estimation of differences with the help of Student’s t-test (p); base data checking for normalcy of distribution concerning the Pearson’s chi-squared test. The statistical analysis of the experimental information was done by the statistical package Statgraphics Plus for Windows and the program Microsoft Excel.

RESULTS AND DISCUSSION

The results of *the gymnastics coaches’ survey* show that 84 per cent believe that the quality of female gymnasts’ feet performance influences the general level of their sport skills. Moreover, another 16 per

cent answered “It’s likely to influence”. That means that in fact all surveyed coaches find this index as an important constituent part of being successful in rhythmic gymnastics competitions.

The following most significant characteristics distinguishing the quality of female gymnasts’ feet performance were pointed out by the respondents: the height of rising to half toe position (88%); the capacity to perform for a long time on one foot and maintain its turnout and the height of half toe position (84%); the capacity to balance for a long time in high turnout half toe position (80%); the degree of toe pointing (72%); and feet turnout (64%).

All respondents (100%) see exercises from traditional choreography as the most effective for improving the quality of feet performance; 60% prefer special exercises from rhythmic gymnastics; 28% favour special groove machines. A large majority of the surveyed maintains that regular choreographic activity is necessary for developing this aspect of female gymnasts’ executive skills. The data collected in response to this question corresponds to the data published in the book “Rhythmic Gymnastics” edited by Professor Ludmila Karpenko (2003).

Generally, the survey results confirmed our initial hypothesis that the feet performance quality is a significant component in gymnastics executive skills that may be developed effectively by the means of traditional choreography.

In Table 2 are the figures gained during the *experimental study revealing the influence of the female gymnasts’ feet performance quality on the general level of*

their sport skills. It's important to note that determining the opposite examined groups in two ways we got practically the same

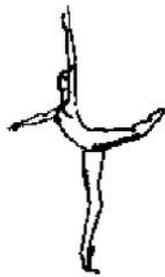
results. That confirms the rightness and objectivity of the pair-wise comparison method for determining the opposite groups.

Table 2. *The estimation of feet performance quality of gymnasts in "strong" (n=6) and "weak" (n=6) groups*

№	Index	«Strong» groups M±m	«Weak» groups M±m	P (t-test)
1	Feet turnout (angle of feet spreading, in degrees)	166.8±2.8	143.9±3.2	p<0.05
2	Height of half toe position (angle between the floor and the arch of foot in half toe position, in degrees)	59.5±1.0	52.5±0.8	p<0.05
3	Rises to high half toe position from the lower rail of the wall-bar (the amount of times per 30 seconds)	48.3±1.3	41.3±2.2	p<0.05
4	Rise to half toe position on right foot (the amount of times)	29.5±2.1	16.0±2.8	p<0.05
5	Rise to half toe position on left foot (the amount of times)	28.3±1.3	17.6±2.5	p<0.05
6	Balance on left foot in passe (sec)	16.7±2.1	5.9±1.0	p<0.05
7	Balance on right foot in attitude (sec)	23.8±1.6	10.0±2.4	p<0.05
8	Tour lent rotations on right foot (the amount of times)	6.7±0.5	3.7±0.3	p<0.05

Our data produced the following facts. The limit angle of feet spreading in the sitting position with hands behind the gymnast in the "strong" group was 166.83⁰ and in the "weak" group 143.92⁰ (p<0.05). The angle between the floor and the arch of foot in half toe position was 59.50⁰ in the "strong" group and 52.58⁰ (p<0,05) in the "weak". The gymnasts in the "strong" group have stronger calf muscles than those in the "weak" group. The "strong" group gymnasts can rise 48.33 times to high half toe position from the low bar per 30 seconds; the number of rises in the "weak" group was 41.33 (p<0.05). The number of rises on the right foot to high half toe position without touching the floor with the other foot and with no time frame in the "strong" group was 29.50, on the left foot 28.33. In the "weak" group the figures were 16.0 and 17.67 respectively. The differences are statistically significant (p<0.05).

As female gymnasts prefer to perform front horizontal lever with the right leg we assessed the ability to balance on the right foot in half toe position through a more difficult lever in attitude (Figure 4). The left leg was assessed when the right was on passé (Figure 5). Interesting that it was the right foot on which the female gymnasts managed to balance on half toe position longer despite the more difficult task for the right leg. The results of gymnasts in the "strong" group were positively better than in the "weak" group (p<0.05): the right foot – 23.88 and 10.05; the left – 16.77 and 5.90 seconds respectively.

Figure 4. *Attitude*Figure 5. *Passé*

Most gymnastics and choreography specialists believe that tour lent rotation is one of the most difficult elements. Its qualitative performing depends on a pivot foot strength, feet turnout and balance function. Tour lent (French: slow rotation) is a slow rotation of 360° (or more) on one foot with the working leg opened for any position of 90° (or higher). Again the results differ considerably: the “strong” group 6.75 rotations; the “weak” group 3.75 rotations. The differences are statistically valid ($p < 0.05$).

We can see that all selected indexes indicate that female gymnasts with higher sports skill level have better feet performance quality. This proves that among other things the feet performance quality helps being successful in gymnastics. Moreover, it confirms that coaches who pay attention to the development of their junior female gymnasts' feet turnout, the height of half toe position, the calf muscles strength, etc., are right.

When developing experimental methods to improve female gymnasts' feet performance quality we considered traditional choreography exercises.

Traditional choreography is a unique set of movements providing the all-round

body development: strength of feet, arms and back, joints and muscles flexibility, steadiness (aplomb), coordination, culture of movements (Vaganova, 1980). According to Karpenko (2003), random exercises from traditional choreography are not effective. For this reason, traditional choreography classes were included in training process in Russia long ago. Usually traditional choreography lessons for women comprise four parts: 1) bar exercises; 2) floor exercises; 3) jumping; 4) training in ballet shoes. Such a structure of the lesson is typical for choreographic academies and dance companies. For better results, ballet dancers have this training practice every day (Kostrovitskaya, Pisarev, 1976; Vaganova, 1980). Still, for a variety of reasons the situation in gymnastic is different.

According to coaches, the duration of a traditional choreography lesson is 90 minutes, followed by the main training. Hence, as a rule, it consists of two parts: bar and floor exercises or bar exercises and jumping or floor exercises and jumping. We discovered that only one coach from Omsk includes training in ballet shoes in the lesson process. Ballet shoes are one of the most effective ways of the ballet dancers' feet training and prevent flat-foot (Figure 6).

Figure 6. *Women ballet shoes (pointe) providing ballet dancers' feet training*

In regards to the frequency of traditional choreography lessons, only the representatives of the elite Olympic rhythmic gymnastics team have daily two-hour trainings. Two or three 1.5-hour

lessons per week is the norm for middle-ranking female gymnasts attending children's and youth sports schools or children's sport clubs (Karpenko, 2007).

Due to the lack of lessons (two or three lessons per week), coaches fail to develop the quality of middle-ranking female gymnasts' feet performance.

In order to settle this problem new traditional choreography methods aiming to improve the feet performance quality have been developed. For this purpose:

- we firstly determine the most effective traditional choreography exercises in relation to feet training and increase their number of them in the lesson structure;

- secondly, we start regular trainings in ballet shoes.

These exercises include:

- releve – (French: raise) – rise to half toe position. It helps to develop calf muscles strength, foot strength, turnout and steadiness. It can be performed at a leisurely or at a quick (mounts to half toe position) pace on two feet (in every position) or one.

- plie – (French: flexion) – squatting. It develops feet strength, hip and ankle joints turnout, ligaments' flexibility, Achilles tendon. There are several kinds of plie: demi plie (French: half flexion) – half squatting and grand plie (French: full flexion) – complete squatting. In addition to plie half toe position is also productive;

- battement tendu (French: beating) – a strained leg movement from one position to another. It improves ankle and hip joints, leg strength and stretch – knees, feet, feet balls, toes.

The proportion of these exercises in the lesson process have been increased:

1) By taking as bases releve and plie, we composed two 10-minutes combinations that can be performed alternatively facing the bar and on the floor:

Combination №1 comprises different kinds of releve performed in every position on one foot changing the speed of movements from two times 4/4 to 1/8 (from 8 times to 1);

Combination №2 consists of releve combinations, all kinds of plie including plie on half toe position. Speed also varies from two times 4/4 to 1/8 (from 8 times to 1).

2) We increased the number of battement tendu compulsive combinations from one or two to three with the duration of 32 times 2/4 each of them (64 times):

Combination №1 includes a set of battement tendu together with plie and releve and is performed at a leisurely pace facing the bar;

Combination №2 was developed on the basis of Combination №1 by adding more difficult variations of the same exercises and is performed at a quicker pace side to the bar or on the floor;

Combination №3 comprises a variety of battement tendu, battement tendu jete (French: hurl) – kick movements with the strained leg on 25° coupled with plie and releve and is performed at a quick pace side to the bar or on the floor.

3) As additional exercises, plie and releve are included in every combination;

4) Many exercises are performed with the support leg on half-toe position or in plie. Traditional choreography trainings were at a frequency of three lessons per week, for 90 min. We based ours on the alternation of two and three partial lessons. As we used all four phases of a traditional lesson (bar exercises, floor exercises, jumping, training in the ballet shoes) six lesson variations have been composed. They shifted during the two weeks (Table 3).

5) The results of the experimental study in regards to our methods on improving female gymnasts' feet performance quality by means of traditional choreography are demonstrated in Table 4. On the whole, our data confirms the effectiveness of the suggested methods. The improvement of the female gymnasts' feet performance quality resulted positively ($p < 0.05$) from the experimental study of the following indexes: the height of rising to half toe

position, the capacity to balance for a long time in high turnout half toe position, the capacity to perform for a long time on one foot and maintain its turnout and the height of half toe position. Even though there is no

reliable evidence ($p>0.05$) of positive dynamic concerning the feet turnout (ankle joints flexibility), we can see that the limit angle of feet spreading in the sitting position with hands behind increased by 3.84^0 .

Table 3. The organization of traditional choreography classes aimed to improving the female gymnasts' feet performance quality

Classes variations	Content of classes	Time
Variation №1	Combination on plie-releve №1 at the bar	10 min
	Bar exercises	30 min
	Floor exercises	20 min
	Training in the ballet-shoes	25 min
Variation №2	Combination plie-releve №1 at the bar	10 min
	Bar exercises	45 min
	Combination on plie-releve №2 on the floor	10 min
	Jumping	25 min
Variation №3	Combination on plie-releve №2 at the bar	10 min
	Floor exercises	40 min
	Combination on plie-releve №1 on the floor	10 min
	Training in the ballet-shoes	25 min
Variation №4	Combination on plie-releve №1 at the bar	10 min
	Bar exercises	45 min
	Combination on plie-releve №2 on the floor	10 min
	Jumping	25 min
Variation №5	Combination on plie-releve №2 at the bar	10 min
	Bar exercises	30 min
	Floor exercises	30 min
	Training in the ballet-shoes	25 min
Variation №6	Combination on plie-releve №2 at the bar	10 min
	Floor exercises	45 min
	Combination on plie-releve №1 on the floor	10 min
	Jumping	25 min

* During trainings in ballet shoes the participants had 5 minutes to change shoes.

Table 4. The estimation of feet performance quality of gymnasts (n=27) before and after the training on experimental training

№	Index	Before the experiment M±m	After the experiment M±m	Diff.	p (t-test)
1	Feet turnout (angle of feet spreading, in degrees)	156.33±2.44	160.17±1.99	3.84	$p>0.05$
2	Height of half toe position (angle between the floor and the arch of foot in half toe position, in degrees)	55.81±0.81	62.32±0.72	6.51	$p<0.05$
3	Rises to high half toe position from the lower rail of the wall-bar (the amount of times per 30 seconds)	41.04±1.68	49.56±0.82	8.52	$p<0.05$
4	Rise to half toe position on right foot (the amount of times)	19.48±1.66	37.89±1.48	18.41	$p<0.05$
5	Rise to half toe position on left foot (the amount of times)	20.70±1.57	35.82±1.14	15.12	$p<0.05$
6	Balance on left foot in passe (sec)	12.90±1.26	21.81±1.84	8.91	$p<0.05$

7	Balance on right foot in attitude (sec)	14.61±1.39	27.75±2.75	13.14	p<0.05
8	Four lent rotations on right foot (the amount of times)	5.17±0.35	7.96±0.49	2.79	p<0.05

On one hand the results of our study correspond with the opinions of Borisenko (2000), Karpenko (2003, 2007), Kalinski, Božanić, Atiković (2011), confirming that traditional choreography trainings are necessary and the feet performance quality need to be improved. On the other hand, our results lead us into a controversy with Nesterova, Makarova (2009) who surveyed a number of coaches many of whom deny the effectiveness of traditional choreography exercises.

CONCLUSIONS

In summary, we can make *the following conclusions*:

- it has been proved that the quality of feet performance is a significant constituent part of the sport skills in gymnastics and among other components it influences gymnast's success in competitions;

- the height of rise to half toe position, the capacity to perform for a long time on one foot and maintain its turnout and the height of half toe position, the capacity to balance for a long time in high turnout half toe position, the degree of toe pointing, feet turnout are the key points of female gymnasts' feet performance quality;

- traditional choreography exercises including training in ballet shoes are effective ways of improving female gymnasts' feet performance quality;

- our methods help improve female gymnasts' feet performance quality.

Ultimately, our methods of improving female gymnasts' feet performance quality by means of traditional choreography, if included in the training process, can raise the chances to success in sports. Experimental testing of this fact will constitute the subject matter of our future study.

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Corresponding author:

Rumba, Olga Gennadievna
Federal State Scientific Establishment
«Institute of Socialization and Education»
of Russian Academy of Education (FSSE
ISE of RAE), Russia, Moscow
e-mail: RumbaOlga@yandex.ru

