ICPESK 2018

International Congress of Physical Education, Sport and Kinetotherapy. Education and Sports Science in the 21st Century, Edition dedicated to the 95th anniversary of UNEFS

ASSESSING THE PSYCHOMOTOR ABILITIES IN BEGINNER GYMNASTS USING THE KOERPERKOORDINATIONSTEST FÜR KINDER

Nicoleta Zaharie (a)*
*Corresponding author

(a) "Lucian Blaga" University, 10 Victoriei Blvd, Sibiu, Romania

Abstract

The aim of the study was both to assess the level of psychomotor abilities using the Koerperkoordinationstest für Kinder (KTK) and to improve coordination and balance in beginner gymnasts. The main target of the research was to improve the evaluation process by diversifying the tests for the two abilities (coordination and balance). The research method applied was the experiment. In this particular case, the study included 36 Romanian gymnasts aged 5-6 years. In order to achieve the objectives, an experimental design was used. A main experiment group and a control group were defined, each group undergoing one initial and one final testing. The main group followed a special program for psychomotor development, which envisaged the development of coordination and balance. The results achieved by the subjects in the experiment group for both tests show that there are statistically significant differences in threshold ($p <= 0.05$) between the initial testing and the final one, as opposed to the case for the subjects in the control group, whose results are irrelevant when applying the same variable. Comparative analysis of the results shows that the psychomotor development program implemented in this study has led to significant changes. The essential element of this study is reflected in the possibility of obtaining a more accurate, realistic and unbiased assessment of the main psychomotor skills in beginner gymnasts. Furthermore, by tailoring special programs of psychomotor development, abilities like coordination and balance can be considerably improved.

1. Introduction

In order to lay stress on the role of evaluating the main psychomotor abilities in the training of novice gymnasts, we chose the KTK test – coordination/movement testing for children (aged 5-14) from the field literature, in translation from German, where it is presented under the "Körperkoordinationstest für Kinder" (KTK) name. The reason for our option was the fact that, for the first part of the initial training, a more particular type of testing would mark out only the individuals experienced in a certain sport, which is neither objective nor beneficial, as many talented children might be excluded (Epuran, 2005).

If the type of effort were specific, some of the subjects would benefit from it due to their ability to master some technical elements. The test results depend primarily on the main qualities of the athletes.

This coordination test designed for children (KTK) was introduced by Ernst J. Kiphard and was published in 1974 by the same Kiphard, together with F. Schilling. The test was certified by a number of institutes over the following years, was presented repeatedly in the programs of many conferences and finally was published in 1979 as a standard test. It was also applied (at least in Germany) in numerous research projects and, in time, has grown to be a baseline in the evaluation of body control development.

2. Problem Statement

The starting point in our investigation was the premise that the main objective of the evaluation by testing consisted in collecting material data on the studied matters, in order to be able to set a prognosis which would target the efficiency level of the evaluation methods and measures used and the scientific guidance of the educational process (Stoian, 2018).

When the training is planned and organized properly, the results are obtained more easily and the performance is increased (Bădescu, 2014).

Also, the study was generated by the researchers' interest in diversifying and enhancing the objectivity of the coordination evaluation methods and measures. Of all coordination elements, we brought forward (segmented and general) coordination and balance, as the most important aspects in women's artistic gymnastics.

Referring to balance, we can assert that it is defined by many scientists in two separate ways: static balance is described as the ability to maintain a base of support with minimal movement, and the second way of defining this skill is dynamic balance, described as the ability to perform a task while maintaining a stable position (Sopa & Pomohaci, 2015).

That is why we considered that the chosen evaluation method would meet the purpose of our research, all the more so as, along the years, the KTK test has revealed the following conclusions:

- Between the ages of 5 and 6, the development of body coordination indicates the highest rate within the 5-12 interval;
- The origin (social background) of the children had an independent role: children coming from families with a more decent social status/background had better results compared to children coming from more precarious social environments.

2.1. Trials

In time, the KTK test has proven to be highly objective if the running instructions were followed closely (Kiphard & Schiling, 2007). The testing materials are standardised and we shall not describe them, as they are already known and we do not have enough space to do it. The KTK test consists of four trials, and we are going to present each of them in our paper.

Note that these trials were adapted to the particular development of psychomotor skills in artistic gymnastics.

- Trial no. 1: Walking backwards in balance in the travel direction (back running)

The test consists in walking backwards the distance of 3 balance beams (6 cm wide), 3 times each. For each attempt on each beam, the gymnast can obtain maximum 8 points. Thus, a subject may obtain 3 x 3 x 8 = 72 points in total.

- Trial no. 2: Hurdle jumping from one foot and landing on the same foot

The test consists of successive jumps (without interruption/rest) over one or six mats (5 cm thick, 60 cm long and 20 cm wide), from one foot to the other, with a 1.5m take-off. For each height, the scores for each attempt will be set as follows: successful exercise for trial no. 1: 3 points; trial no. 2: 2 points; trial no. 3: 1 point. Exercises for each foot shall be scored separately and, in the end, the results will be cumulated.

- Trial no. 3: Left-right side jumps (take-off from both feet and landing on both feet)

The trial consists of alternative jumps to the left and to the right from both feet, with landing on both feet as well, over a wooden strip board placed in the middle of a mat, for 15 seconds. The result after two valid attempts will be added to the total points.

- Trial no. 4: Lateral translating of a wooden board

The trial consists in moving (translating) a board as many times as possible (in two attempts), from one side to the other side of the board, the subject standing on for 20 seconds. The translation may occur optionally to the left and/or to the right. Points will be scored for the number of all the moved boards, as well as for each translation of the subject's body, as follows: 1 point when the board touches the ground after it was moved/translated by the executor, 2 points when the subject moved both feet onto the next board, and 3 points when the next board was moved/translated etc. The scores recorded for two valid attempts will be entered into the exercise protocol and will be added to the general score.

Preliminary exercises are designed for each trial, with the purpose of facilitating the adaptation process to the task and to the additional means to be used during testing. Full data delivery to each child is essential, with no omissions, in order to gradually discover (for each case in particular) the effort limit and the optimum effect or result, by progressively enhancing the difficulty of the exercises. At the same time, we set forth to put the subjects to several tests belonging to the Bruininks-Oseretsky set (1978).

The segment coordination tests (items/trials no. 4 and 5) consisted in performing jumps on the same spot, first combining synchronised moves of the arm and leg on the same side, then synchronised moves of the opposite arm and leg. Both trials last 90 min.

The evaluation of dynamic balance was achieved using the balance test from the same set (item/ trial no. 8), which consisted in walking forward on a beam (13 cm wide and 11 cm high) overstepping an obstacle (stick) placed at a height slightly below the subject's knee.

According to the rules of the Bruininks-Oseretsky set of tests, the results of the mentioned trials are marked with grades (admitted/rejected or completed/not completed).

A detailed description of the way the trials/tests are being carried out and the interpretation of the results can be found in *Metode de psihodiagnostic* (Horghidan, 1997, pp. 146-148 and 171-172).

2.2. The content of coordination and balance improvement program

The experiment group underwent a training program with the purpose of improving coordination and balance. The action systems were organized so as to comply with the classic rules dictated by educational practice. So, 4 cycles of 10 lessons each were created, where each action system found its well-defined place. Training sessions took place twice a week and lasted 90 minutes. During the first part of each lesson, the members of the experiment group were given 50-55 minutes to apply the intervention program set in the research experiment. The control group participated in the same number of training sessions, with the same duration as the experiment group, and the training sessions did not contain the exercises from the experimental group program.

Due to the fact that we do not possess enough space, we shall further select some examples of exercises used in the improvement of the two psychomotor skills we have been focusing on so far: coordination and balance.

2.2.1. Operational examples for the improvement of motor coordination in jumps

a. 4-5 small hoops (38 cm in diameter) are placed in front of two rows of subjects. The distance between hoops is determined according to the performers' abilities. Subjects perform jumps inside the hoop keeping their legs together, alternating with jumps outside the hoops keeping their legs apart – out; running along the hoops up to the starting point – home.

b. Same exercise, but this time with jumps on both feet from one hoop to another

No. of exercises: 2; rest: 30". Working formation: 2 lines

c. Same exercises as a. and b., but in pairwise competition. The hoop line must not be stepped on.

The performer finishing first and with no penalties wins.

No. of exercises: 2; rest: 1". Working formation: 2 subjects in lines

d. Walking in balance on an upside-down bench, jumping off the bench; 1-2m forward running, full turning (360º) on the ground (on a chalk line); walking on a second bench with a 360º turn half-distance; after jumping down the bench, lifting two elastic/rubber balls under both arms, running towards the fixed ladder, placing the balls on the ground, climbing the fixed ladder and descending; running towards the starting point.

No. of exercises: 2; rest: 1". Working formation: one line

2.2.2. Operational examples for dynamic balance improvement

a. Walking on toes on the gymnastic bench, jumping off at the end of the bench, landing with knees bent – out; walking on herringbone "stones" – home

b. Same exercise, but walking along the bench on the whole sole, with the right shoulder pointing forward

c. Same exercise, but walking along the bench on the whole sole, with the left shoulder pointing forward

d. Walking on the gymnastic bench, stepping over two hurdles placed 20 cm above the floor level, jumping off at the end of the bench – out; walking on "stones" arranged in a circle – home

e. Same exercise, but walking on the gymnastic bench and stepping over three buoys. The execution takes place alternatively on each foot.

f. Walking on full sole on the upside-down bench, jumping down at the end of the bench, bent-knee landing – out; walking on herringbone "stones" – home

g. Exercises from examples b. and c. – performed on the upside-down bench

h. Walking on the upside-down gymnastic bench stepping over 1-2 hurdles placed 30 cm above the ground, jumping down at the end of the bench – out; walking on "stones" arranged in a circle – home

No. of exercises: 2; rest: 3". Working formation: 1 line

3. Research Questions

By using the KTK test, one can achieve an objective assessment of the efficiency level of the means used to improve coordination and balance, as well as the scientific guiding of the training in beginner gymnasts.

4. Purpose of the Study

The aim of the study was both to assess the level of psychomotor abilities using the Koerperkoordinationstest für Kinder (KTK) and to improve coordination and balance in beginner gymnasts. The main target of the study consists in an improvement in the evaluation process by diversifying the coordination and balance testing methods, as well as combining them.

5. Research Methods

The research method applied was the experiment, which included 36 Romanian gymnasts aged 5-6 years, having 1-2 years of motor experience. In order to achieve the objectives, an experimental design was used, involving a control group and an experiment group, each group being subject to one initial and one final testing. The experiment group was tested using the independent variable, namely a special program designed for the improvement of motor abilities, which lasted 6 months and mainly targeted coordination and balance improvement.

The following research methods were also used: bibliographical research, active educational observation, statistical-mathematical data processing and graphical representation methods.

6. Findings

Four different tables were created to record the scores (two for the experiment group, two for the control group), entering the results scored by each subject in the intial and the final testing. The generic table is presented below (Table 01).

Table 01. Generic table used separately for both study groups to record the results obtained in the initial and the final testing

	Trial 1 Walking backwards in balance	**Trial 2 One-foot hurdle jumping**	**Trial 3 Side jumps**	**Trial 4 Lateral translating**	
Subjects (1-18)	Measured skill: Dynamic balance	Measured skills: Expansion and general coordination	Measured skills: Dynamic balance and segment coordination in acceleration	Measured skills: Adroitness and dynamic balance in acceleration	**KTK test**
	Results (in no. of steps)	Results (in cumulated points right foot + left foot)	Results (in no. of jumps/15 s)	Results (in no. of translations/20s)	Total score
Arithmetic mean (AM)					

To have an overview of the results obtained by both groups participating in the experiment in the initial and the final testing, for all four trials, we created the summarising table below (Table 02):

Table 02. Results obtained by the control group and the experimental group in both tests

Group	**Test**	**Trial 1 Walking backwards in balance**	**Trial 2 One-foot hurdle jumping**	**Trial 3 Side jumps**	**Trial 4 Lateral translating**	**Total**
Control group	Initial	39.39	21.61	28	23.39	112.39
	Final	42.11	21.67	29.17	24	116.94
Experiment group	Initial	38.44	25.44	32.28	28.17	124.33
	Final	41.78	26.33	34	29.89	132

Note: Arithmetic mean is expressed in points.

Thus, analysing the data obtained by the experiment group in the final test, we noticed that the arithmetic mean values were higher than the average values scored by the control group, in three out of four trials. The only exception was in trial no. 1 ("walking backwards in balance in the travel direction/ back running"). Also, the total of points scored in all four trials altogether (the "total KTK" test) was higher for the experiment group.

A comparative analysis of the results recorded in the next summarising table indicates that the level of progress made by the experiment group is higher than the level of progress made by the control group in all four trials. Thus, the highest level of progress was recorded in trial no. 1 ("walking backwards in balance"), followed, with the same score, by trial no. 3 ("side jumps") and trial no. 4 ("lateral translating"), while the last place was occupied by the progress recorded in trial no. 2 ("one-foot hurdle jumping"). (Table 03)

Table 03. Summarising table containing the results of trials, according to statistical markers

Test/Trial	Subject groups	AM	M	SD	AD	D	Range	VF	Progress*
Trial 1	Control	42.11	41	10.69	9.46	114.32	34	0.25	2.72
	Experiment	41.78	38	11.35	10.17	128.73	36	0.27	3.34
Trial 2	Control	21.67	22	5.91	4.85	34.89	18	0.27	0.06
	Experiment	26.33	27.5	5.48	4.41	30	20	0.21	0.89
Trial 3	Control	29.17	25.5	13.01	10.65	169.25	51	0.45	1.17
	Experiment	34	33.5	12.16	10	147.89	44	0.36	1.72
Trial 4	Control	24	22	5.43	4.33	29.44	19	0.23	0.61
	Experiment	29.89	29	7.96	6.78	63.32	31	0.27	1.72
"total KTK" test (cumulated)	Control	116.94	113	29.94	23.82	896.27	99	0.26	4.55
	Experiment	132	128	28.88	24.44	830.44	102	0.22	7.67

Legend – AM: arithmetic mean; M: median; SD: standard deviation; AD: average deviation; D: dispersion (variance);
VF: Variation factor

* Note that progress is expressed in points and indicated by the number value of the difference between the arithmetic mean scored by the group in the initial testing and the arithmetic mean scored in the final testing.

The data obtained during the research were processed using relevant statistical parameters, which allowed us to make a complete and complex analysis of the studied phenomena. Thus, the following seven statistical parameters were calculated: arithmetic mean, median, standard deviation, average deviation, variance (dispersion), range and the variation factor. The t-Student test was used to verify the statistical assumptions.

The charts illustrating the scores in the following tables and figures contain data recorded in both types of testing and in both groups analysed in the study: the control group and the experiment group (Tables 04 and 05, Figures 01 and 02).

Table 04. Assessing coordination and balance using the "total KTK" test (cumulated points in 4 trials) for the control group

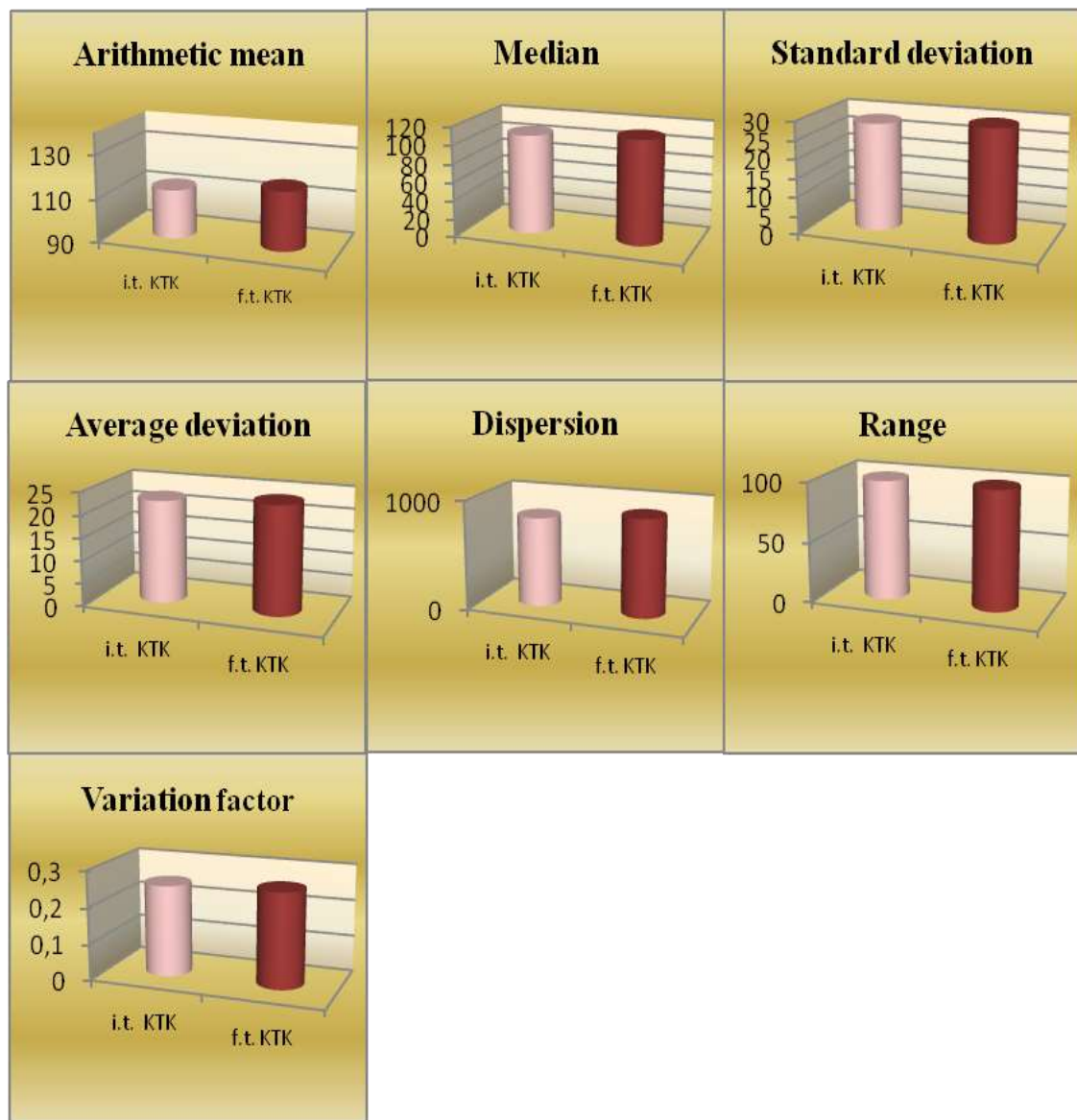| Control group	Arithmetic mean	Median	Standard deviation	Average deviation	Dispersion	Range	Variation factor
Initial testing	112.39	107.5	28.64	22.59	820.13	99	0.25
Final testing	116.94	113	29.94	23.82	896.27	99	0.26
T-Student test	**Hypothesis**		**Invariables**			**Calculated value**	
	H_0	H_1	α	df_1	df_2		
	$m_1=m_2$	$m_1 \neq m_2$	0.05	1	18	**p = 0.006**	
Conclusion	p <= 0.05. Statistically, the results do not differ significantly. Null hypothesis is not						

Figure 01. The KTK test – Control group

Table 05. Assessing coordination and balance using the "total KTK" test (cumulated points in 4 trials) for the experiment group

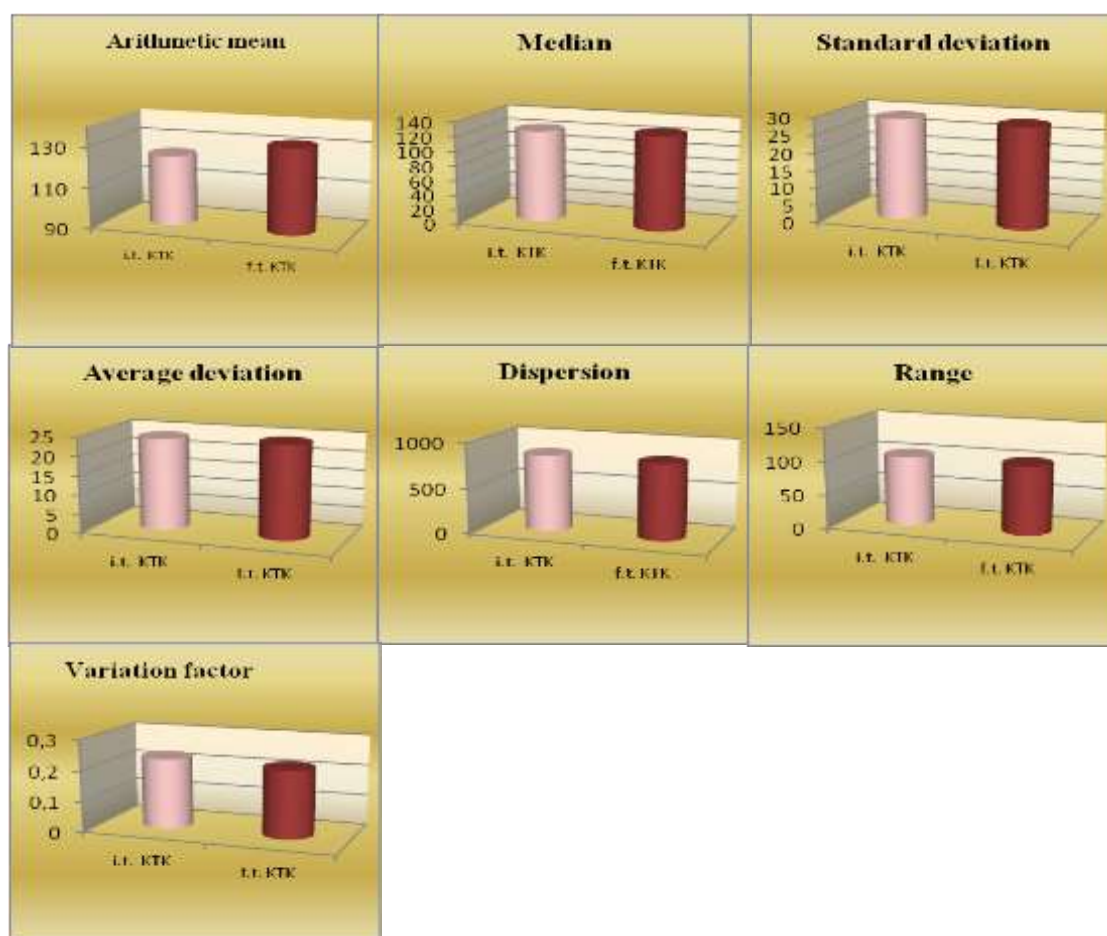| Experiment group	Arithmetic mean	Median	Standard deviation	Average deviation	Dispersion	Range	Variation factor
Initial testing	124.33	124.5	29.07	24	845	103	0.23
Final testing	132	128	28.82	24.44	830.44	102	0.22
T-Student Test	**Hypothesis**		**Invariables**			**Calculated value**	
	H_0	**H_1**	**A**	**df_1**	**df_2**		
	$m_1=m_2$	$m_1 \neq m_2$	0.05	1	18	**p = 0.445**	
Conclusion	p => 0.05. Statistically, the results differ significantly. Null hypothesis is rejected.						

Figure 02. The KTK test – The experiment group

The results obtained by the subjects in the experiment group for the two tests indicate that there are statistically significant changes ($p \leq 0.05$) between the initial and the final testing, as opposed to the control group in which case the results are insignificant on the same variable.

Data analysis and interpretation were performed for all trials by comparing the results of each group (control and experiment) separately from one testing to another, but also between groups, with an emphasis on the results scored in the final testing. We underline that during the process of analysing and interpreting the data, the leading standard among value judgments was primarily the progress scored between the initial and the final testing, especially by the experiment group. Also, considering the central direction of the data series, we find that the arithmetic mean values are highly representative, accurate, close to the truth, all the more so as they are backed-up or consolidated/"doubled" by the median values.

7. Conclusion

The study indicated that, in the initial KTK test, the subjects having richer motor experience (2 years) scored better in the dynamic balance trials (no. 1 and 3).

Also, in the initial testing (the KTK test), no differences related to the motor experience of the subjects were found during trial no. 4, reflecting adroitness when in speed.

During the KTK test, the trial that challenged the subjects the most was the expansion and general coordination (trial no. 2), all the more so as it also targeted the ability to estimate the distance, a quality which develops more slowly at the age of 5-6.

Trials consisting in performing motor actions in acceleration (trials no. 3 and 4) were the most popular among children, these trials becoming genuine competitions.

By conducting a comparative analysis of the tests and trials used, we noticed that the subjects were more receptive, dynamic, attentive and curious when the KTK test was used.

As opposed to the Bruininks-Oseretsky set of tests, which provides the usage of grades in recording the results, the KTK test uses numbers to indicate the results, conferring a higher degree of objectivity.

A comparative analysis of the results obtained after using the KTK test shows that the coordination and balance development program implemented in this study has led to significant changes and the processed data, which confirms the remarkable progress scored by the gymnasts in the experiment group with regard to the level of development of the main psychomotor skills.

The assessment of the results achieved in this study bears a general character and can be useful to coaches during the process of identifying prime motor skills in athletes, but also for a subsequent guidance of the training process.

Choosing the KTK test from the German field literature, adapting and applying it to pre-school gymnasts, constitutes a refinement in the evaluation of the main elements of coordination.

The study can be seen as a premise in creating improved assessment/training strategies for beginner gymnasts, diversifying tests and trials, perfecting score grids and conferring objectivity to the interpretation of tests and/or trials. The experiment has shown that, by tailoring special programs of psychomotor development, abilities like coordination and balance can be considerably improved for 5-6-year-old gymnasts, all the more so as, at this age, coordination development is adequate.

By using the KTK test, one can perform an objective evaluation of the efficiency level of the methods used in coordination and balance development and scientifically guide the training process for beginner gymnasts.

References

Bădescu, D. (2014). Study on forecasting and prediction, their role and importance in sports training high performance. *Bulletin of the Transilvania University of Braşov, 8*(2), 19-24.

Bruininks, R.H. (1978). *Bruininks-Oseretsky Test of Motor Proficiency: Examiner's manual.* Circle Pines, MN: American Guidance Service.

Epuran, M. (2005). *Metodologia cercetării activităţilor corporale*. Bucureşti: FEST.

Horghidan, V. (1997). *Metode de psihodiagnostic*. Bucureşti: Editura Didactică şi Pedagogică, R.A.

Kiphard, E. J., & Schiling, F. (2007). *Körperkoordinationstest für kinder*. Göttingen: Beltz Test.

Sopa, I. S., & Pomohaci, M. (2015). Developing balance and mobility at primary school level. *International Scientific Conference "Sport, Education, Culture – Interdisciplinary approaches in scientific research"*, Galaţi, 28-30 May 2015. Retrieved from https://www.researchgate.net/publication/283300468_Developing_Balance_And_Mobility_At_Primary_School_Level

Stoian, I. (2018). Periodic testing – A prerequisite for an exact determination of physical training standards. *The European Proceedings of Social & Behavioural Sciences, XXXVI*, 318-324. https://dx.doi.org/10.15405/epsbs.2018.03.42