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RELATION BETWEEN THE LATENT MOTOR DIMENSIONS RESPONSIBLE FOR MOVEMENTS OF STUDENTS IN ACQUIRING THE MOTOR TESTS

INTRODUCTION

The physical education and upbringing is an integral part of the educational and upbringing teaching process involving all students from the earliest age. The previous analysis provide clear guidance to further expansion, burdening and harmonization of existing programs and program contents with the new challenges and trends. At the same time the analysis of situation, qualities and dispositions that students have a basis for further development of quality work program, which is of course aimed at further development of the individual and further raising the level of knowledge and achievements. Accurate information and obtaining accurate information about the level of motor skills, habits and abilities of students are the basis for further rising. The correct choice of assessment methods and development of instruments, will allow collection of valid data for learning, teaching and achievements of every student. Proper evaluation and assessment, where the student's achievements, knowledge, skills, made effort, activity and behavior will contribute to proper selection, direction and determination in the life. Analogue to this, it is very important to have a continuous and uninterrupted monitoring of the individual development, along with the transformation processes caused during the teaching, because on that way can be observed positive changes, but also and any shortcomings, which is of paramount importance for the further individual development, science and the teaching-upbringing process in general.

The subject of our study was primary school students from the Republic of Macedonia and Republic of Serbia, who regularly follow the teaching process. The goal is to see what kind of connection makes the results and achievements from the motor tests' assessments with the latent motor dimensions.

METHODS OF WORK

The sample of respondents was defined on the population of students who regularly attended classes in the primary education in the Republic of Macedonia (the region of Prespa and Pelagonia) and R. Serbia (the region of Banat, Kikinda municipality). The total number of respondents was 179, of which 124 from the Republic of Macedonia and 55 from the Republic of Serbia, composed of students from the eighth grade at age of 14-15 years (±3 months). For getting the data, into account were taken thirteen variables for assessment of motor skills: jump forward from a place (SDM), triple jump from a place (TDM), running at 20 meters from high

start (T20VIS) running at 50 meters from high start (T50BIS), push-ups (SKL), raising the trunk from the ground (PTT), chinning (VIZ); dynamometric of the stronger hand (DPR); taping by hand (TPR), darts (PIK), horizontal target shooting with a ball (GHT), balance with eyes closed (RZO) and deep bent on the bench (PDK). The evaluation of achievements and results was made at six motor tests. Two tests for the assessment of explosive strength (SDM and TDM), two tests for assessment of the starting speed (T20VIS and T50VIS) and two tests for assessment of the precision (PIK and GHT). The assessment was carried out by a numeric scale from 1 to 5 (scale of standard deviation). Separately from every two grades obtained from the assessment of the given parameters was extracted one summative assessment.

The data from all variables was treated by the basic descriptive statistical parameters, and previously their normality of distribution was tested by the method of Kolmogorov and Smirnov. The factorization of the data was conducted by the Hotelling's method of main components. The number of significant principal components was determined on the basis of Kaiser-Gutman's criterion. According to it, as a significant was taken every possible component with calculated characteristic root that is equal to or greater than 1.00. The significant main components were transformed into varimax and direct oblimin position with parallel and orthogonal projections. The data processing for the connection of the achievements, results and grades with the latent dimensions of motor tests was performed by a regression analysis.

RESEARCH RESULTS AND DISCUSSION

In the review of Tables 1, 2 and 3 are given the basic descriptive parameters from the motor variables of respondents. Defined were: the number of respondents (Valid N), the arithmetic mean (Mean), minimum and maximum score (Minimum, Maximum), distance (Rang), variance (Variance), standard deviation (Std.Dev.), skewness (Skewness) and kurtosis (Kurtosis). Based on the gained results were defined the upper and lower limit values for each individual indicator and the distance between them. The evaluation of the given indicators was performed with a standard deviation scale (numeric scale from one to five). Based on the gained results was defined the lower and upper limit of the obtained grades that ranged from one to five.

Table 1. *Descriptive statistical parameters from the motor abilities at students from the Republic of Macedonia*

Descriptive Statistics (adstudy.sta)	Valid N	Mean	Minimum	Maximum	Range	Variance	Std.Dev.	Skewness	Kurtosis
SDM	124	180	110	238	128	732,553	27,066	-0,337	-0,301
TDM	124	553,15	400	697	297	4681,654	68,423	-0,223	-0,385
T20VIS	124	38,59	32	67	35	27,236	5,219	1,997	7,916
T50VIS	124	78,25	64	122	58	99,327	9,966	1,129	1,871
SKL	124	6,96	0	21	21	24,332	4,933	0,761	-0,224
ПРТТ	124	22,47	10	40	30	24,739	4,974	0,126	0,140

VIZ	124	24,65	0	84	84	338,066	18,387	1,022	0,814
DPR	124	28,61	12	41	29	38,451	6,201	-0,119	-0,352
TPR	124	36,01	17	56	39	59,130	7,690	0,298	-0,044
PIK	124	32,18	13	44	31	84,245	9,178	-0,483	-1,158
GHT	124	16,93	4	37	33	54,946	7,413	0,725	-0,110
RZO	124	24,36	3,94	75	71,06	305,630	17,482	1,113	0,245
DPK	124	40,56	15	62	47	58,785	7,667	-0,152	0,830

Skewness values of most indicators point to an asymmetric distribution of results. Excluding at Skewness was observed at the indicators among respondents from the Republic of Macedonia: running at 20 meters from high start (Skewness=2,00) and the respondents from the Republic of Serbia at the indicators: running at 20 meters from high start (Skewness=2,26); running at 50 meters from high start (Skewness=1,80) and balance with closed eyes (Skewness=1,52). Kurtosis values for most indicators are below the limit values, therefore the distributions are considered platikurtic. Leptokurtic, was noticed among respondents from the Republic of Macedonia at the indicators: running at 20 meters from high start (Kurtosis = 7,92), while at the respondents from the Republic of Serbia was recorded at variables: running at 20 meters from high start (Kurtosis = 7,17) and running at 50 meters from high start (Kurtosis = 5,39).

Table 2. *Descriptive statistical parameters from the motor abilities at students from the Republic of Serbia*

Descriptive Statistics (adstudy.sta)									
	Valid N	Mean	Minimum	Maximum	Range	Variance	Std.Dev.	Skewness	Kurtosis
SDM	55	174,85	105	220	115	590,682	24,304	-0,571	-0,007
TDM	55	551,98	374	647	273	3070,314	55,41	-0,963	1,581
T20VIS	55	36,42	32	55	23	17,211	4,149	2,257	7,167
T50VIS	55	80,56	66	123	57	97,028	9,85	1,800	5,393
SKL	55	3,45	0	14	14	14,215	3,77	1,026	0,033
ПРТТ	55	26,91	13	36	23	21,899	4,68	-0,352	0,223
VIZ	55	50,73	0	82	82	522,795	22,865	-0,670	-0,380
DPR	55	27,4	15	36	21	16,059	4,007	-0,699	0,577
TPR	55	44,13	28	55	27	31,595	5,621	-0,406	0,458
PIK	55	24,25	15	34	19	18,008	4,244	-0,158	-0,442
GHT	55	21,15	14	28	14	15,386	3,923	-0,260	-0,936
RZO	55	47,78	7	149	142	1206,396	34,733	1,515	1,588
DPK	55	60,04	42	77	35	51,888	7,203	0,191	0,308

Table 3. *Descriptive statistical parameters of students' achievements and grades*

Descriptive Statistics (adstudy.sta)										
		Valid N	Mean	Minimum	Maximum	Range	Variance	Std.Dev.	Skewness	Kurtosis
Macedonia	SLJ	124	3,27	1,00	5,00	4,00	0,684	0,827	-0,759	0,572
	SPEED	124	3,44	1,00	5,00	4,00	0,584	0,764	-0,941	0,840
	PREC	124	3,25	2,00	4,00	2,00	0,267	0,517	0,288	-0,264
Serbia	SLJ	55	3,27	1,00	5,00	4,00	1,059	1,029	-0,283	-0,312
	SPEED	55	3,30	1,00	5,00	4,00	0,813	0,901	-0,426	-0,054
	PREC	55	3,27	2,00	5,00	3,00	0,591	0,769	0,794	0,462

From inspection of Table. 4 according to the Hoteling's method is shown a factor matrix of thirteen variables for assessing the motor space, communality, the important characteristic roots, the percentage of the total explained variance and the orthogonal varimax rotation.

The system of motor variables among respondents from the Republic of Macedonia established two significant principal components that explained the percentage of the total variance by 40.44%. From the two main components, the largest contribution in the explaining has the first, which explained the total variability by 27,91% (LAMBDA = 3,63), and the second by12,53% (LAMBDA = 1,63). From inspection of the unrotated factor matrix can be seen that the first principal component is saturated by more variables (except variables PTT, VIZ, TPR, PIK, GHT, RZO and DPK). The participation of the saturations in the formation of the first principal component was ranged from 0.37 at the variable dynamometric of the stronger hand (DPR) to 0,70 at the variable running at 50 meters from high start (T50VIS). It is evident that some of the manifested variables are factor complexes, specifically they do not measure only one factor, they are also saturated and by another factor. After the orthogonal varimaxx rotation of the initial coordinate system of the manifest variables were obtained two latent dimensions defined as factors:

(F1) Energy factor for regulation of movements, which retained significant projections towards variables for estimation of the energy movement's regulation (SDM, TDM, T20VIS, T50VIS, SKL, PTT and DPR), with saturation from 0.39 to 0.82 Analyzing the size of vectors, i.e. communality of the applied system of motor variables, that define the first factor the highest values shows the variable T50VIS ($h^2 = 0,72$).

(F2) Factor for central regulation of movements, which retained significant projections towards variables for estimation of the central regulation of movements (TPR, PIK and DPK), with saturation from 0.20 to 0.81. Analyzing the size of vectors, i.e. communality of the applied system of motor variables that define the second factor, the highest values were noted at the variable PIK ($h^2 = 0,41$).

Table 4. *Factor analysis of the applied system of motor abilities at students*

Macedonia	H			Factor	Factor	Serbia	H			Factor	Factor
	F1	F2	h	1	2		F1	F2	h	1	2
SDM	0,563	0,676	0,611	**0,816**	0,102	**SDM**	0,642	0,643	0,635	**0,748**	0,288
TDM	0,575	0,683	0,596	**0,821**	0,091	**TDM**	0,758	0,779	0,731	**0,87**	0,148
T20VIS	0,472	0,474	0,599	**0,67**	-0,159	**T20VIS**	0,663	0,764	0,831	**-0,873**	0,033
T50VIS	0,696	0,743	0,724	**0,734**	-0,451	**T50VIS**	0,686	0,770	0,868	**-0,878**	0,004
SKL	0,498	0,526	0,48	**0,626**	-0,366	**SKL**	0,427	0,436	0,515	0,648	0,124
ПРТТ	0,056	0,375	0,183	0,392	0,471	**ПРТТ**	0,400	0,408	0,405	0,570	0,287
VIZ	0,005	0,298	0,148	0,091	0,539	**VIZ**	0,557	0,642	0,664	0,800	-0,031
DPR	0,367	0,368	0,388	**0,566**	-0,219	**DPR**	0,297	0,301	0,372	0,535	0,120
TPR	0,039	0,089	0,240	0,255	0,204	**TPR**	0,427	0,428	0,481	0,606	0,245
PIK	0,155	0,681	0,408	-0,165	**0,808**	**PIK**	0,084	0,661	0,434	0,026	**0,813**
GHT	0,096	0,106	0,298	0,325	0,003	**GHT**	0,614	0,619	0,612	0,717	0,324
RZO	0,027	0,03	0,154	0,174	0,01	**RZO**	0,252	0,609	0,43	0,279	**0,729**
DPK	0,078	0,208	0,222	-0,161	0,426	**DPK**	0,116	0,700	0,438	0,073	**0,833**
Eigenval			**Eigenval**			**Eigenval**			**Eigenval**		
LAMBDA	**3,628**	**1,629**	**Cumul.**		**5,257**	**LAMBDA**	**5,924**	**1,835**	**Cumul.**		**7,759**
Variance			**Eigenval**			**Variance**			**Eigenval**		
TARG %	**27,908**	**12,531**	**CUM %**		**40,439**	**TARG %**	**45,569**	**14,113**	**CUM %**		**59,683**

The system of motor variables among respondents from the Republic of Serbia established two significant principal components that explained the percentage of the total variance by 59.68%. Of the two main components, the largest contribution in explaining has the first that explained the total variability by 45,57% (LAMBDA = 5,92), and the second by 14,11% (LAMBDA = 1,86). From the inspection of the unrotated factor matrix can be seen that the first principal component is saturated by many variables (except variables PIK and DPK). The participation of the saturations in the formation of the first principal component was ranged from 0.25 of the variable balance with closed eyes (RZO) to 0.77 in the variable triple jump from a place (TDM). It is evident that some of the manifested variables are factor complexes, specifically they do not measure only one factor, they are also saturated and by another factor. After executing the orthogonal VARIMAX rotation of the initial coordinate system of the manifest variables were obtained two latent dimensions defined as factors:

(F1) Energy factor for regulation of movements, which retained significant projections towards variables for estimation of the energy movement's regulation (SDM, TDM, T20VIS, T50VIS, SKL, PTT, WIZ and DPR), with saturation from 0,54 to 0, 88. Analyzing the size of vectors, i.e. communality of the applied system of motor variables that define the first factor the highest values shows variable T50VIS (h^2 =0,87).

(F2) Factor for central regulation of movements, which retained significant projections towards variables for estimation of the central regulation of movements (TPR, PIK, GHT, RZO and DPK), with saturation from 0.25 to 0.83. Analyzing the size of vectors, i.e. communality of the applied system of motor variables that define the second factor, the highest values showed the variable GHT ($h^2 = 0,61$).

From the inspection of the Table. 5 can be seen that multiple regression analysis of the system was done using achievements and obtained scores with the latent motor dimensions at students from the Republic of Macedonia.

The coefficient of multiple correlation, i.e. the correlation of the system from the performed assessment as predictors with the criterion latent motor dimension (F1) defined as an energy factor for regulation of movements, was R=.92, and the prediction coefficient R^2=.84, which means it explains the common variability of about 84%. Such a relationship was significant at the level of p =,000. The remaining 16% are in explaining the total variability remains of some other features and capabilities of respondents which are not the subject of this research (e.g. assessment of other motor variables, morphological measures, conative, cognitive, motivational, functional, etc.). From the analysis of the impact of individual motor indicators, may be noted that the three indicators have positive medium and low significant influence on the criterion.

The coefficient of multiple correlation, i.e. correlation of the system by the performed assessment as predictors, with the criterion latent motor dimension (F2) defined as a factor for central regulation of movements, was R=.58, and the prediction coefficient R^2=.33, which means it explains the common variability of about 33%. Such a relationship was significant at the level of p =,000. The remaining 67% remains in explaining of the total variability of some other features and capabilities of respondents which are not a subject of this research (e.g. assessment of other motor variables, morphological measures, conative, cognitive, motivational, functional, etc.). From the analysis of the impact of individual motor indicators, may be noted that a significant negative impact has the indicator jump forward (BETA=-0,496), which is significant at the p-level = .000. At the indicator jump forward was determined significant medium negative individual impact on the criterion (B = -0.482). Individually low and medium positive statistically significant impact on the criteria was noticed among the indicators assessment of sprinter speed and precision.

From the inspection in the Table. 6 can be seen that was carried out a multiple regression analysis on the system of achievements and obtained grades with the latent motor dimensions at students from the Republic of Serbia.

The coefficient of multiple correlation, i.e. the system's correlation of performed assessment as predictors with the criterion latent motor dimension (F1) defined as a factor for energy regulation of movements, was R = .82, and the prediction coefficient R^2 = .68, which means it explaining the common variability with about 68%. Such a relationship was significant at the level of p=,000. The remaining 32% remains in explaining of the total variability of some other features and capabilities of respondents which are not a subject of this research (e.g. assessment of other motor variables, morphological measures, conative, cognitive, motivational, functional, etc.). From the

analysis of the impact of individual motor indicators may be noted that the both indicators jump forward and the sprinter speed have a positive medium significant impact on the criteria.

The coefficient of multiple correlation, i.e. correlation of the system from the performed assessment as predictors with the criterion latent motor dimension (F2) defined as a factor for central regulation of movements, was R = .54, and the prediction coefficient R^2 = .29, which means it explains the common variability with about 29%. Such a relationship was significant at the level of p =, 000. The remaining 71% remains in explaining of the total variability of some other features and capabilities of respondents which are not a subject of this research (e.g. assessment of other motor variables, morphological measures, conative, cognitive, motivational, functional, etc.). From the analysis of the impact of individual motor indicators may be noted individually very high and statistically positive significant impact on the criteria defined by the indicator precision score.

Table 5. *Regression analysis of F1 and F2 –the factor for energy and central regulation of movements with the system of indicators from the assessing during motor tests among respondents from the Republic of Macedonia.*

Regression Summary for Dependent Variable: FAC 1 R= ,91825433 RI= ,84319101 Adjusted RI= ,83927079 F(3,120)=215,09 p<0,0000 Std.Error of estimate: ,40091							**F1**	Regression Summary for Dependent Variable: FAC 2 R= ,57509704 RI= ,33073661 Adjusted RI= ,3140050 F(3,120)=19,767 p<,00000 Std.Error of estimate: ,82825						**F2**
	BETA	St. Err. of BETA	B	St. Err. of B	t(120)	p-level		BETA	St. Err. of BETA	B	St. Err. of B	t(120)	p-level	
SLJ	0,514	0,042	0,500	0,041	12,107	0,000		-0,496	0,088	-0,482	0,085	-5,652	0,000	
SPEED	0,449	0,043	0,498	0,048	10,426	0,000		0,188	0,089	0,208	0,099	2,112	0,037	
PREC	0,207	0,038	0,269	0,049	5,492	0,000		0,443	0,078	0,576	0,101	5,689	0,000	

Table 6. *Regression analysis of F1 and F2 –the factor for energy and central regulation of movements with the system of indicators from the assessing during motor tests among respondents from the Republic of Serbia.*

Regression Summary for Dependent Variable: FAC 1 R= ,82391952 RI= ,67884338 Adjusted RI=,65995181 F(3,51)=35,934 p<,00000 Std.Error of estimate: ,58314							**F1**	Regression Summary for Dependent Variable: FAC 2 R= ,54351988 RI= ,29541386 Adjusted RI= ,25396762 F(3,51)=7,1276 p<,00043 Std.Error of estimate: ,86373						**F2**
	BETA	St. Err. of BETA	B	St. Err. of B	t(51)	p-level		BETA	St. Err. of BETA	B	St. Err. of B	t(51)	p-level	
SLJ	0,379	0,105	0,458	0,127	3,598	0,001		0,219	0,156	0,265	0,188	1,406	0,166	
SPEED	0,477	0,102	0,624	0,134	4,658	0,000		-0,277	0,152	-0,363	0,198	-1,828	0,073	
PREC	0,124	0,085	0,240	0,165	1,458	0,151		0,496	0,126	0,959	0,244	3,934	0,000	

CONCLUSION

From the obtained results in the survey can be concluded the following:

- ♣ Based on the applied factor analysis in the analyzed motor area at the two samples of respondents (Republic of Macedonia and Republic of Serbia) were extracted by two latent dimensions defined as: (F1) factor for energy regulation of movements and (F2) factor for central regulation of movements.
- ♣ The system of applied variables in which was made achievements' assessing among students of the both samples (Republic of Macedonia and Republic of Serbia) noted statistically significant impact by the both latent dimensions (F1 and F2).
- ♣ Based on the extracted latent dimension, F1 - factor for energy regulation of the movements, noted individually positive statistically significant impact at all three indicators of the performed evaluation of participants from the Republic of Macedonia, while individually positive statistically significant impact among respondents from the Republic of Serbia was observed at the indicators jump forward and sprinter speed.
- ♣ Based on the extracted latent dimension, F2 - factor for central regulation of the movements, was defined individually negative statistically significant impact on the indicators gained from the evaluation at jump forward among the respondents from the Republic of Macedonia, while very high statistically significant impact among respondents from the Republic of Serbia was defined by the indicator grade for precision.

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RELATION BETWEEN THE LATENT MOTOR DIMENSIONS RESPONSIBLE FOR MOVEMENTS OF STUDENTS IN ACQUIRING THE MOTOR TESTS

The research has been carried out on a sample defined by the population of students who attended regularly their training classes in primary school in the Republic of Macedonia (from the region of Prespa and Pelagonia) and the Republic of Serbia (from the region of Banat, municipality Kikinda). The total number of entities is 179, of which 124 are from Macedonia, and 55 – from Serbia who are eight-grade students, aged 14-15 (± 3 months). The aim of the study is to establish the relation between the results and obtained marks in motor tests with the latent motor dimensions responsible for the movements of students. By using factor analysis – varimax rotation, there is determined the effect and relation between the marks obtained in acquiring the motor tests for estimating the explosive power, start speed, and precisity of students.

Key words: *estimation, motor abilities, factor analysis, regressive analysis.*