

A COMPARATIVE ANALYSIS OF THE MOTOR LATENT DIMENSIONS WHICH OCCUR AS A RESULT OF VARIOUS TYPES OF PHYSICAL EXERCISE

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Abstract

This research was carried out to answer some of the questions which are most directly related to the realization of physical education classes in elementary schools. The basic problem is whether only alternative programs (those which have been used in a great number of studies) or existing programs can influence the transformations of certain segments of anthropological status. The subject matter of this paper are motor skills, while the aim is defined as the comparative analysis of the latent variables of groups of participants who practiced different programs during their physical education classes. The sample of participants consisted of 120 boys aged 8, divided into two groups, one of which N=60 practiced judo during their physical education classes, and a second one N=60, which exercised following the program prescribed by the Ministry of Education. The sample of variables consisted of 12 variables of motor skills. For the evaluation of motor skills, we used the following manifest variables from the structural model of motor skills: 1. Hand tapping (TAPR), 2. The polygon backwards (PLN), 3. The three-ball slalom (S3M), 4. Hyperextensions (DPK), 5. Standing on one leg (SJM), 6. Side movements of the torso (ISK), 7. The standing depth jump (SDM), 8. Running sideways (TUS), 9. Throwing a medicine ball from a prone position (BML), 10. Hanging leg raises (INS), 11. Leg raises from a prone position (DNL) and 12. Torso lifts (DTT). The data were processed by means of a component analysis using the DRSTAT package. The research indicates that after one year of various physical education exercise programs, the first latent variables which carry the greatest information value for both groups of participants were defined as the general motor factors, and that the other latent variables represent different factors of motor skills. There is no doubt that the aims of physical education, defined in such a manner, require an individual approach which must be based on information regarding the motor skills of each student and the initial state of the relative abilities and features.

Keywords: boys, elementary schools, judo, manifest variables, latent variables, component analysis

INTRODUCTION

Numerous studies that have been carried out both here and abroad, regarding the influence of physical exercises on the development of anthropological status (Bala, 1981; Bala, Kis & Popović, 1996; Toskić, 2000; Malacko,

2005; Stanković & Popović, 2009; Milojević & Stanković, 2010; Stanković & Malacko, 2011), have unequivocally indicated that with the proper organization of work and adequate dosing of the intensity and extent of the load, we can influence the development of almost all the segments

of anthropological status. This is of extreme importance for physical education as one of the means by which the complete psycho-physical personality of the child can be formed. Without knowing the influence of the means of physical education on the dimensions of personality, we cannot know the extent to which the set goals were achieved. In addition, it is necessary to know the values of the means which are necessary for the realization of the set goal (Stanković & Malacko, 2008) so that we could select only those which are most useful and most effective in achieving the goal of a healthy, capable and happy child (Toskić, 2000, Popović, 1980, Stanković & Popović, 2009).

Numerous papers have been written in the field of motor space, which primarily deal with the manifest and latent characteristics of people. In the studies carried out so far, the greatest numbers of authors have studied the problems of the structure of motor skills, that is, the identification of latent structures used to define that space (Gredelj, Metikoš, Hošek & Momirović, 1975; Kurelić, Momirović, Stojanović, Šturm, Radojević & Viski-Štalec, 1975; Stanković, 2001). This research was carried out with the aim of determining the differences in the structure of the motor skills of children who participated in various physical exercise programs.

METHODS

The sample of participants consisted of 120 boys aged 8 who were divided into two groups, one N=60 which trained judo during their physical education classes and another group N=60 which trained following the program prescribed by the Ministry of Education.

The sample of variables consisted of 12 variables of motor skills. To evaluate motor skills from the structural model of motor skills (Gredelj, Hošek, Metikoš, Momirović, 1975), the following manifest variables were used: to evaluate the *structuring of movement* - 1. Hand tapping (TAPR), 2. The polygon backwards (PLN), 2. The three-ball slalom (S3M), to evaluate the *tonus regulation and synergy regulation* - 4. Hyperextensions (DPK), 5. Standing on one leg (S3N), 6. Side movements of the torso (ISK), to evaluate the *intensity of excitation regulation* - 7. The standing depth jump (SDM), 8. Running to the side (TUS), 9. Throwing a medicine ball from a prone position (BML), to evaluate the *duration of excitation regulation* - 10. Hanging leg raises (INS), 11. Leg lifts from a prone position (DNL) and 12. Torso lifts (DTT).

The data were processed using a component analysis and with the help of the DRSTAT

statistical package described and developed by Popović (1993) at the Center of Multidisciplinary Research of the Faculty of Sport and Physical Education in Leposavić.

RESULTS AND DISCUSSION

The interpretation of the isolated motor latent variables, due to limited space, was carried out with the help of the slant transform matrix, which contains parallel projections, that is, the length of the vectors in the coordinate system.

Table 1. The slant transform matrix and the intercorrelation of the factors of motor variables of the students who trained judo

	Lv-1	Lv-2	Lv-3	Lv-4	h ²
TAR	.16	.01	.21	.74*	.67
PLN	-.57*	-.04	-.06	-.14	.40
S3M	-.70*	-.10	-.20	.00	.60
DPK	-.12	.04	.79*	.32	.73
SUK	.09	.26	.26	-.57*	.50
ISK	.10	-.08	.78*	-.28	.69
SUM	.81*	-.02	-.22	-.22	.67
TUS	-.72*	-.21	-.00	.02	.63
BML	.74*	-.27	-.01	.22	.64
INS	-.01	.92*	-.16	.00	.82
DNL	.00	.81*	.15	-.09	.74
DTT	.26	.46	-.06	.50*	.60

	Lv-1	Lv-2	Lv-3	Lv-4
Lv-1	1.00			
Lv-2	.22	1.00		
Lv-3	.06	.14	1.00	
Lv-4	.16	-.04	.00	1.00

Legend: Lv-1 - the first latent variable, Lv-2 - the second latent variable, Lv-3 - the third latent variable, Lv-4 - the fourth latent variable, h² - variable communalities, TAR - hand tapping, PLN - the polygon backwards, S3M - the three-ball slalom, DPK - hyperextensions, S3N - standing on one leg, ISK - side movements of the torso, SDM - the standing depth jump, TUS - running sideways, BML - throwing a medicine ball from a prone position, INS - hanging leg raises, DNL - leg lifts from a prone position, DTT - torso lifts.

The first latent variable (Lv-1) in the case of students who trained judo (table 1) could be defined as the latent variable responsible for the structuring of movement and for the regulation of the intensity of excitation. Since at the level of the latent variables of a higher order there is no significant common mechanism, this latent

dimension should be interpreted as the general factor of motor skills.

The second latent dimension is defined as the latent dimension responsible for the regulation of the duration of excitation since even the parallel projection of tests of hanging leg raises and leg lifts from a prone position as well as their orthogonal projections are exceptionally high and range from .81 to .92. Using this group of variables we can make the most reliable evaluations of the static and repetitive strength.

The third one represents the flexibility factor and the greatest projections with this latent dimension were found for hyperextensions whose orthogonal projection is .79 and the side movements whose orthogonal projection was .78. Thus, this latent dimension can be nominated as a unique dimension of flexibility.

The fourth factor has high projections with the hand tapping test, balance and torso lifts with a load. This factor cannot be interpreted in a rational way since this is probably a case of a mathematical artifact.

In the intercorrelation matrix of the latent dimensions we obtained a low connection between the first and second latent dimension. This connection has a value of .22 but it is sufficient to explain the connection between the general motor factor and the mechanism for the regulation of excitation duration.

After everything that we have outlined here, the direct conclusion is as following: since it is not in the nature of the child to solve many motor tasks in which the energy component of high intensity is dominant, and the so-called "explosive strength" is more a characteristics of the state of the CNS toward which we, due to considerable genetic determinacy, can not influence significantly, the problem of the general motor abilities of children of this age is been lefted to be analyzed by means of information components of the motor tasks. At the same time we are primarily referring to structuring of the movement (various types of coordination), regulation of the inclusion of agonist and antagonist muscles, as well as the regulation of muscle tonus. Functionally speaking, the general motor skills of children in this period of their development probably depend on the effective functioning of the entire CNS. This effectiveness is reflected in the quality of the receptors, especially the kinesthetic ones, muscular and tendonal, afferent pathways, decoders in the cortical and subcortical part of the CNS, then in the corticospinal and subcorticospinal pathways, front motor neurons in the spinal column, motor units and overall muscle-effector. The ability of

manifesting greater body strength, at this age, has not been pronounced. We are primarily referring to the generation of muscle force, which should move the body into a different position. All the isotonic and isometric character contractions are necessary for the realization of the motor tests which were used in the program of motor measuring, offering information regarding the so-called "relative strength" and give an evaluation of the endurance of the appropriate muscles. Nevertheless, it is certain that such a partial motor skill is still not sufficiently developed, which is a completely normal characteristic of the ontogenetic development of a man.

Table 2. The slant transform matrix and the intercorrelation of the factors of motor variables of students during their regular physical education classes

	Lv-1	Lv-2	Lv-3	Lv-4	h ²
TAR	.01	.80*	.13	.13	.67
PLN	-.75*	-.23	-.13	-.18	.73
S3M	-.72*	-.14	.17	-.03	.57
DPK	-.07	.59*	.04	-.46	.61
SUK	.15	-.22	.67*	-.17	.56
ISK	-.01	.02	-.08	.89*	.80
SUM	.66*	.26	-.03	-.21	.63
TUS	-.66*	.07	-.20	.10	.52
BML	.70*	-.15	-.13	-.07	.49
INS	-.09	.32	.78*	.05	.72
DNL	.29	.70*	-.16	-.09	.68
DTT	.70*	-.06	.31	.22	.68
	Lv-1	Lv-2	Lv-3	Lv-4	
Lv-1	1.00				
Lv-2	.17	1.00			
Lv-3	.13	.04	1.00		
Lv-4	-.06	-.10	-.00	1.00	

Legend: Lv-1 - the first latent variable, Lv-2 - the second latent variable, Lv-3 - the third latent variable, Lv-4 - the fourth latent variable, h² - variable communalities, TAR - hand tapping, PLN - the polygon backwards, S3M - the three-ball slalom, DPK - hyperextensions, SJN - standing on one leg, ISK - side movements of the torso, SDM - the standing depth jump, TUS - running sideways, BML - throwing a medicine ball from a prone position, INS - hanging leg raises, DNL - leg lifts from a prone position, DTT - torso lifts.

The calculated oblimin rotation of the initial coordinate system (table 2.) of the motor variables of the students who regularly attended

physical education classes indicates the following structure.

The first latent dimension is responsible for coordination and for the complete energy regulation of movement, and could be interpreted as the general factor of motor skills. It was defined using the tests of coordination of explosive strength, speed and repetitive leg strength. The common characteristic of the aforementioned tests, except for the final one, are short-term muscle contractions, caused by the maximal extent of the excitation originating from the CNS, which causes the excitation of the maximal possible number of motor units. This type of muscle action as a consequence has the quick and explosive development of force, and thus this dimension is most often defined as explosive strength. The projection of the standing depth jump variable also confirms the nomination of the factor. The distance of the landing is proportional to the square of the takeoff. When speaking of tests used to evaluate repetitive strength, we must say that the characteristics of these tests include the possibility of developing great excitation in the primary motor centers of the cortex and those subcortical nuclei which function as amplifiers or efferent information modulators (Stanković, 2001). In this case, we are dealing with a dimension which can be explained by the character of the regulation of movement in the primary motor centers and the subcortical area of the CNS. Considering this conclusion, these dimensions, with a certain amount of caution, could be defined as the latent functional structure, which is responsible for the regulation of the duration of excitation of the primary motor centers which manage the movements of active muscles. It appears that even in this research, the sampling theory developed by Thompson (Kirkendall & Gruber, 1970; Popović & Simonović, 2008), that there is only one general ability, which represents the combination of elementary abilities, has been confirmed. The aforementioned elementary abilities studied in this research, with a sample defined in this manner, are considered as a potential.

The second latent dimension is a factor responsible for the speed of simple movements. This measuring instrument defines the ability to quickly perform simple motor tasks, but due to the extraordinary motor demands, classifies

it into the category of coordination tests. Considering the fact that the speed by which the complex motor tasks are solved and performed, is an essential feature of the content of most tasks, which best defines this definition, it could be concluded that the basis of this dimension represents a mechanism for the structuring of movement.

The third latent dimension is far more complex and is defined by two different types of activities using static strength (INS) and the balance (SUK). The characteristic of the test of static torso strength is the development of maximal possible strength under normal conditions (the so-called. "attempted movement"). We must, nevertheless, emphasize that the final outcome does not depend only on the current activation of the agonist, but actually on the cumulative effect of the successive inclusion of a greater number of motor units, so that in the moment of greatest tension, the greatest number of muscle fibers is activated. At the same time, the muscles which generate force are activated, whose direction is not concordant with the activated agonists, and they serve them to ensure better foothold (they are used as fixators). Maximal muscle strength depends, of course, on the number of activated muscle units, and this number, obviously, is not independent of the number of available units which can even be activated, and thus, does not depend on the active muscle mass. The connection between the force and balance can be explained physiologically, and primarily by the structure of the muscle fibers which are responsible for the successful manifestation of these primary motor skills. Each skeletal muscle consists of a mixture of so-called quick and slow muscle fibers and other fibers which are classified as belonging somewhere between these two extremes. For the successful performance on the tests of static strength and balance, what is most important are the so-called slow muscle fibers which have the following physiological characteristics: these are two smaller fibers, enervated by a thinner fibers, and which have more developed system of blood vessels and capillaries to ensure an additional amounts of oxygen, and have a significantly greater number of mitochondria and large amounts of myoglobin.

The fourth latent dimension represents a single agility factor (ISK), which is responsible

for arm mobility and mobility of the shoulder belt. The relations between the obtained factors are quite low, except for the relations between the first latent dimension with the second and third factor. Further proof for this lies in the claim that the energy component plays an important part in coordination manifestation and also the balance.

CONCLUSION

This research was meant to answer some questions which are most directly bound to the realization of physical education classes in elementary school. The basic problem is whether only the alternative programs (those which have been used in a variety of studies) or the existing programs can influence toward the transformations of certain segments of anthropological status. The subject matter of this paper are the motor skills while the goal is defined as the comparative analysis of latent variables of the groups of participants who were practicing by following different programs as part of their physical education classes. The research indicates that after one year of different physical education programs, the first latent variables which carry the greatest informative value, for both groups of participants, has been defined as a general factors of motor skills, while the remaining latent variables represents a different motor skills factors. Knowledge of motor skills, which comprises the development of motor dimensions and their ability to increase the influence of various stimuli, today more than ever, have been applied in the practice of kinesiology. Nevertheless, it is considered that this application in kinesiology exclusively refers to that part which is connected to the competitive sport, especially the kind which has pretensions of being a top sport. Of course, most of the problems cannot be solved with a help of the results of this research, but a more thorough application of the results from this research is possible in the field of physical education, especially for a class work. Namely, the aims of physical education can be defined as transformation of all the positive features, in a positive direction, as well as to decrease or to channel all the negative abilities, with the help of kinesiological operators. At the same time we emphasize the requirement for the system of kinesiological operators to be selected so that they could finally result in as

great as possible i interconnectedness between all the positive features (both abilities and features) and also as great as possible interconnection between the positive and the negative features. No doubt that this kind defined physical education requires an individual approach which must be based on information about the motor abilities of each student, as well as on the initial state in which are the relevant skills and the qualities.

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КОМПАРАТИВНА АНАЛИЗА НА МОТОРНИТЕ ЛАТЕНТНИ ДИМЕНЗИИ КОИ СЕ ДЕФИНИРАНИ ПО ДЕЛУВАЊЕТО НА РАЗЛИЧНИ ПРОГРАМИ НА ФИЗИЧКО ВЕЖБАЊЕ

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(Оригинале научен труд)

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Апстракт

Ова истражување треба да одговори на некои прашања кои се непосредно поврзани со реализацијата на наставата по физичко воспитување во основното училиште.

Притоа, основен проблем е дали само алтернативните (кои се применети во голем број на истражувања) или и постојните програми можат да влијаат врз трансформациите на одделни сегменти на антрополошкиот статус. Предметот на истражувањето се моторните способности, додека целта е дефинирана како компаративна анализа на латентните варијабли кај групи испитаници кои вежбаа со различни програми на часовите по физичко воспитување. Примерокот на испитаниците беше сочинет од 120 деца на возраст од 8 години, разделени во две групи испитаници. Едната (60) на часовите по физичко воспитување вежбаше џудо, а другата реализираше програма која беше пропишана од Министерството за просвета. Примерокот на варијабли беше сочинет од вкупно 12 тестови за проценување на моторните способности. Беа применети следните тестови: 1. тапинг со рака (ТАПР), 2. полигон наназад (ПЛН), 3. слалом со три медицинки (СЗМ), 4. длабок претклон на клупа (ДПК), 5. стојење на една нога (СЕН), 6. искрет на трупот (ИСК), 7. скок во далечина од место (СДМ), 8. трчање во страна (ТВС), 9. фрлање медицинка од лежење (ФМЛ), 10. издржување на нозете на сандак (ИНС), 11. подигнување на нозете од лежење (ПНЛ) и 12. подигнување на трупот (ПТТ). Истражувањето покажа дека по едногодишното делување на различните програми на физичкото вежбање, првите латентни варијабли кои носат најголема информативна вредност во двете групи испитаници, дефинираа генерален фактор на моторика, а другите латентни варијабли репрезентираа различни фактори на моторните способности. Без сомнение е дека на овој начин дефинираните цели на физичкото воспитување налагаат индивидуален пристап кој мора да се базира врз информациите за моторните способности на секој ученик как ои врз почетната состојба во која се наоѓаат релевантните способности и особини.

Клучни зборови: деца, основни училишта, џудо, манифестни варијабли, латентни варијабли, компронентна анализа

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