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Motor Performance and Academic Achievement in Special School Students with Intellectual Disabilities

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Abstract:

Aim. The concept of the integrated development or the interrelationship between motor and intellectual abilities has served as the foundation of a number of theories of child development and of learning. It has been assumed by many that the learning and the performance of motor skills are closely related to intelligence. The basic purpose of this study was to determine the significance of the gender (male/female) difference, grade-level differences in the basic motor development, related to the different IQ-maturity subcategories. Additionally, of special interest in this study was to establish the correlations among variables for the estimation of chronological age (Age/M), academic achievement (ScSs), intellectual maturity (IQ) and motor development (PFT) of Special Secondary School Students, using Pearson's, Kendall's, and Spearman's Correlations Coefficient. (r).

Methods. The total sample of 176 subjects of both genders (118 male and 58 female) was included in the study. *Instruments:* A battery of Physical Fitness Tests (PFT) for the evaluation of motor development was applied (Fjørtoft et al. 2003), comprising nine different tasks (including running, jumping, throwing and climbing) for the estimation of explosive strength, running speed, agility and endurance of participants.

Results. The significant relationship was estimated between chronological age and educational performance (at 0.5* level), and between IQ-maturity and educational performance (at 0.1* level) with Kendall's (.416) and Spearman's (.537) Correlation coefficient. Physical Fitness Tests (PFT) items scores were transformed into standardized *z*-score, and have not established significant correlation with other variables within total sample of participants.

Conclusion. General conclusion, derived from results of this study, provided within Special education of Secondary school students do not support constant link between PET variables and common indices of academic achievement, such as average various educational subjects marks (grade-points). Continued research is needed to gain more causal understanding of the relationship between motor (physical fitness) and intellectual performance in children with special needs (intellectual disabilities). Future research should address and explain which parameters of physical fitness and activities obtain the greatest cognitive benefits, examine the effects of physical activity and fitness by cohorts, and investigate which moderators have the greatest impact on student cognition and education performance in children with intellectual disabilities, as these factors are important contributors to their health and well-being.

Key words: Special Education; Secondary school students, Motor and Intellectual Performance; Physical-Fitness-Test; Intellectual disability, Academic achievement

1. Introduction

Motor functions are directly in relation with cognitive and affective functions of a personality, particularly in the period of early school age, so that without significant impulse of motor development it is not possible to realize the idea of necessity of integral development of children. As the contribution to the hypothesis that the efficacy in tests for the estimation of motor abilities is possible to explain with integral function of CNS, which represents as well the basis of intellectual functioning, speak the result of Reitana, 1971 (*after Gredelj, Metikoš, Hošekova & Momirović, 1975,* pp. 18-19), which point out that group of children with cerebral damage have as well weaker results in both cognitive and motor function, on the which base author made

conclude that the cognitive and motor abilities are in relation **Physical activity** is defined as any bodily movement produced by skeletal muscle resulting in a substantial increase in resting energy expenditure *(Bouchard & Shepard, 1994)* They are citing seven categories of physical activity (exercise, sport, training play, dance, work, and domestic chores), suggested that patterns of physical activity could be described by manipulating the variable of frequency (how often), intensity (how hard), and duration (how long) after *Winnick, 2005* (p. 402). *Casperson, Powell, and Christenson (1985, p. 129)* defined **Physical fitness** as a *"set of attributes that people have or achieve that relates to the ability to perform physical activity"*. The components of physical fitness may be subdivided into two groups: health-related fitness and skill/performance-related fitness. The everyday activities require that children master different motor skills *(Henderson & Sugden, 1992)*. Among these are the skills essential to biological functioning like crawling, walking and running, as well as those required for adequate social functioning, like dressing and playing.

Over the years, several studies have compared the physical fitness performance of youth with disabilities to that of youth without disabilities. With few exceptions, research using subjects with intellectual disabilities, cerebral palsy, spinal cord injuries, and visual impairments has found that the fitness performance of youngsters with disabilities is below that of their peers without disabilities. To the extent that the fitness of youngsters with disabilities falls below acceptable levels, it is probable that students with disabilities are at greater risk for the health concerns mentioned previously than are students without disabilities (after *Winnick, 2005, p. 404)*. Individuals with intellectual disabilities present a diversity of abilities and potential, and educators must be prepared to accept this diversity. Intellectual disabilities present a substantial disadvantage to an individual attempting to function in society. They are characterized by cognitive limitations as well as functional limitations in such areas as daily living skills, social skills, and communication.

PHYSICAL AND MOTOR CHARACTERISTICS OF CHILDREN WITH INTELLECTUAL DISABILITIES.

Children with intellectual disabilities differ least from children without intellectual disabilities in their motor characteristics. Although most children with intellectual disabilities display developmental motor delays, they are often related more to the limited attention and comprehension than to physiological or motor control deficit. As a group, children with intellectual disabilities walk and talk later, are slightly shorter, and usually are more susceptible to physical problems and illnesses than other children. In comparative studies, children with intellectual disabilities consistently score lower than children without intellectual disabilities on measures of strength, endurance, agility, balance, running speed, flexibility and reaction time.

Although many students with intellectual disabilities can successfully compete with their peers without intellectual disabilities, those students needing extensive or pervasive supports have a discrepancy equivalent to four or more years behind their peers without intellectual disabilities on tests of physical fitness and motor performance *(after Winnick, 2005, p. 141)*. Important contribution to the explanation of a structure of motor abilities was given by the results of those researches in which the relation of cognitive and personality characteristics and motor abilities was investigated. In investigation of relation of motor abilities and intellectual abilities one of the very first studies was that of Kulcinskaja, 1945 (after *Ismail, 1977*) which established that the relation of intelligence and learning of basic motor tasks is higher, when the intellectual level of examinees is higher. Based on the above demonstrated theoretical approach, and literature review of previous research findings the basic ***Aim*** of this study was to determine the significance of differences in ***motor development***, estimated through the results in Physical Fitness Test (PFT) of the school age children in relation to the different ***Intellectual maturity(IQ) sub-categories***. The logical ***hypothesis*** was stated that there will be stated positive and statistically significant differences between examined groups of participants in applied battery of Physical Fitness relative to the additional indicators of special interests in this study, considered criterion (IQ).

2. Methods

A *cohort* sample **(N=129,** Male-77; Female-52**)** of upper Elementary (aged 11-12 to 15-17 years), and Secondary school participants (aged 18-21 years) was derived from the *global* sample of Children, attending both Special Elementary and Secondary School (**N=282;** M-190, F-92), which represents the whole sample of pupils in these age groups in the school selected in an urban area of the city of Nis (the second large in Serbia). A *cohort* sample (of smaller size) completed the Test of Physical Fitness (TPF) after *Fjørtoft et al., 2003*. The samples include children with intellectual disabilities in a wide range of socio-economic backgrounds and reflect the population of children attending special schools in this area. The sub-samples of examinees consist of both, girls and boys (see Table 1, below).

Physical Fitness Test (PFT) is relatively a new test battery that aims to provide a reliable, objective quantification of children's physical fitness levels (*Fjørtoft et al. 2003; Haga 2008*). It consists of activities that are included in most children's everyday play activities, e.g. *jumping, throwing, running and climbing.* The battery consists of nine test items: (3) three based on jumping; (2) two on throwing; (1) one on climbing, and (3) three on running. For that reason this battery is applicable for the participants with low motor competence, as were considered those with intellectual

disabilities. The test battery is simple to set up and is not time demanding, which was also the reason for its selection. Most test items are also included in other measures such as the EUROFIT *(Adam et al. 1998),* the Allgemeiner Sportsmotorischer Test 6–11 *(Bös & Wohlman 1987),* the Erfarenheter från Folke Bernadottehemet (FBH-provet) *(Bille et al. 1992)* and The Prudential Fitnessgram *(Cooper Institute for Aerobics Research, 2001)*. The test item *"climbing wall bars"* was especially designed for the TPF. Test–retest correlation of total score of the TPF is high, 0.90. The construct validity of the test was 0.93 for girls and 0.89 for boys (Spearman's correlation). The validation was performed by an experienced physical education teacher who was asked to rank 10 girls and 10 boys in his class from lowest to highest physical fitness, according to his own implicit knowledge *(Fjørtoft et al. 2003)*.

Table 1. Presentation of the research samples size, according to the school level, gender, and class-level

Sample	N	**Global** – larger size (N=282)				N	Sample
Elementary		Male	Female	Male	Female		Secondary
V-VIII	106	72	34	118	58	176	I - IV
Total		106		176			Total
		282					
Sample	N	**Cohort** – smaller size (N=129)				N	Sample
Elementary		Male	Female	Male	Female		Secondary
V-VIII	77	51	26	38	14	52	I - IV
Total		77		52			Total
		129					
Sample	N	**Sub-samples** (N=129)				N	Sample
Elementary		Male	Female	Male	Female		Secondary
V - VI	37	26	11	25	8	33	I - II
VII -VIII	40	25	15	13	6	19	III - IV
Total	77	51	26	38	14	52	Total
Elementary		77		52			Secondary
Total		**129**					Total

Additional indicators – criterion variables: (IQ) Intellectual maturity was provided by the School officials in charge, school psychologist, and social worker (see below Table 2).

Table 2. Characteristics of the IQ (intellectual maturity) categories of participants

Code	Category	IQ
1-A	Moderate impairments of intellectual development	48 and less
2-B	Intellectual development on the border between moderate and low impairments	49-50
3-C	Intellectual development in lower range of low impairments	51-54
4-D	Intellectual development in the middle range of impairments (mild)	55-65
5-E	Intellectual development in the upper range of impairments	66-68
6-F	Intellectual development between low and borderline level of impairments	69-70
7-G	Borderline level of intellectual development	71-79
8-H	Below-average level of intellectual development	80-89
9-I	Average level of intellectual development	90-109

Research management. The study was carried out in accordance with the Declaration of Helsinki. The assessments of physical fitness took place in the school sports/gym hall with test protocol in accordance with the TPF manual during the timetabled Physical Education session for each particular class. All the children in the sample voluntarily completed the measurements, during the period of two months (May, 7th – Jun, 10th 2011) at the end of the Elementary, and (May, 7th – Jun, 17th 2011) Secondary School Year.

Data processing. Study Results were processed using Basic (descriptive) statistics, Univariate and Multivariate Analysis of Variance Models, as well as Discriminative Analysis Methods using SPSS version 10.0 or higher, edited by *Ntoumanis, N. , 2001***.**

3. Results and interpretation

Analysis of the motor development in Elementary and Secondary school participants, relative to the intellectual maturity (IQ). In accordance with previously stated study design, in this part of the study the thematic segment of the participants *"motor development"* in Elementary and Secondary school participants relative to the *"intellectual maturity"* divided in 3 sub-categories: IQ (48-54) (n=56), IQ (55-70) (n=50), IQ (71-109) (n=23).

Table 1. Analysis of group's differences in Performance of Physical Fitness Tests

Data Analysis	n	F	p
MANOVA	9	2.305	.002
DISCRA	9	2.317	.002

Legend: MANOVA – *Multivariate Analysis of Variance;* DISCRA – *Discriminative analysis*; **n –** *number of variables*; **F-***ratio**;* **p -** *probability*

While is ***p***=.002 of (MANOVA) and ***p***=.002 of (DISCRA) analysis, stated hypothesis had to be accepted, while differences are evident and there is a clearly defined border between IQ maturity sub-categories of the elementary and secondary school participants.

Table 2. DISCRA analysis of the estimated (PET) variables

(PFT)	F	P	C.disc.
StBJ	5.143	.007	.001
2S7m	5.457	.005	.005
1S7m	5.498	.005	.025
TenB	2.889	.059	.027
MedB	3.064	.050	.001
Clmb	6.704	.002	.056
10X5	3.135	.047	.018
R20m	5.321	.006	.081
MCT6	6.309	.002	.000

Legend*: **C.disc.** - Discriminative coefficient;* **F-***ratio**;* ***p*** **-** *probability*

(PFT)*: **StBJ-**standing broad jump; **2S7m-**jumping on two feet a distance of 7m; **1S7m-**jumping a distance of 7m on one foot; **TenB-**throwing a tennis ball with one hand; **MedB-**pushing a medicine ball with two hands as far as possible; **Clmb-**climbing wall bars, crossing over two columns to the right, and down the fourth column as fast as possible; **10X5-** shuttle run; **R20m-**running 20m as fast as possible; **MCT6-**reduced Cooper test*

While is p<.1 stated hypothesis had to be accepted, which means that there are evident significant differences within some sub-categories of IQ maturity of participants in majority of tests.

CHARACTERISTICS AND HOMOGENEITY OF THE PARTICIPANT'S *INTELLECTUAL MATURITY* (IQ), RELATIVE TO THE MOTOR DEVELOPMENT IN SPECIAL SCHOOL CHILDREN

On the bases of presented consideration and sample analysis of 129 participants and in accordance to the applied methodology, the logical follow-up of the research is estimation of the characteristics and homogeneity of every (IQ) intellectual maturity sub-category of the participants and mutual distance between them.

Table 3. Significance of the difference between IQ maturity and (PFT) variables

(PFT)	IQ sub-categories		Mean		t	p
StBJ	IQ (48-54)	IQ (71-109)	108.357	136.87	3.219	.002
StBJ	IQ (55-70)	IQ (71-109)	116.920	136.87	2.229	.029
2S7m*	IQ (48-54)	IQ (71-109)	5.197	3.6	3.100	.003
2S7m*	IQ (55-70)	IQ (71-109)	4.736	3.6	2.918	.005
1S7m*	IQ (48-54)	IQ (55-70)	4.718	4.122	1.745	.084
1S7m*	IQ (48-54)	IQ (71-109)	4.718	3.355	3.010	.004
1S7m*	IQ (55-70)	IQ (71-109)	4.122	3.355	2.137	.036
TenB	IQ (48-54)	IQ (71-109)	15.060	19.271	1.979	.051
TenB	IQ (55-70)	IQ (71-109)	14.526	19.271	2.484	.015
MedB	IQ (48-54)	IQ (71-109)	5.565	6.746	2.536	.013
Clmb*	IQ (48-54)	IQ (55-70)	19.594	16.344	1.742	.084
Clmb*	IQ (48-54)	IQ (71-109)	19.594	11.444	3.159	.002
Clmb*	IQ (55-70)	IQ (71-109)	16.344	11.444	3.055	.003
10X5*	IQ (48-54)	IQ (55-70)	32.552	27.772	2.042	.044
R20m*	IQ (48-54)	IQ (55-70)	6.015	7.483	1.895	.062
R20m*	IQ (48-54)	IQ (71-109)	6.015	4.56	2.093	.040
R20m*	IQ (55-70)	IQ (71-109)	7.483	4.56	2.777	.007
MCT6	IQ (48-54)	IQ (55-70)	631.357	706.52	2.159	.033
MCT6	IQ (48-54)	IQ (71-109)	631.357	783.913	3.493	.001

Legend: *Mean - mean value;* **t** *– t-test;* **p** *– probability,* ***IQ*** *– intellectual maturity,* *****reversible values*

Table 4. Characteristics and homogeneity of the IQ maturity sub-categories in Special school participants, relative to (PET) variables

(PFT)	IQ (48-54)	IQ (55-70)	IQ (71-109)	Ctrb. %
R20m	moderate* [1]	higher* [2]	smaller	37.850
Clmb	higher* [2]	moderate* [1]	smaller	26.168
TenB	moderate	smaller	higher* [2]	12.617
1S7m	higher* [2]	moderate* [1]	smaller	11.682
10X5	higher* [1]	moderate	smaller	8.411
2S7m	higher* [1]	moderate* [1]	smaller	2.336
StBJ	smaller	moderate	higher* [2]	.467
MedB	smaller	moderate	higher* [1]	.467
MCT6	smaller	moderate* [1]	higher* [1]	.000
n/m	36/56	24/50	16/23	
hmg %	64.29%	48.00%	69.57%	

Legend: hmg % *- homogeneity;* ***ctrb. %****- contribution of variable to IQ maturity sub-category characteristics*

Table 5. Mahalanobi's distance among IQ maturity sub-categories of (PET) variables

	IQ (48-54)	IQ (55-70)	IQ (71-109)
IQ (48-54)	.00	1.04	1.20
IQ (55-70)	1.04	.00	.91
IQ (71-109)	1.20	.91	.00

By calculating of the Mahalanobis's distance among IQ maturity sub-categories of participants we have another single indicator of the similarity or differences.

Based on presented ***dendogram*** and ***Graph 1*** (see below) it is evident that the closest are IQ (55-70) and IQ (71-109) sub-categories of the intellectual maturity with the distance of (.91), and the highest difference is between IQ (48-54) and IQ (55-70) sub-categories of the intellectual maturity with the distance of (1.15).

4. Conclusions

Based on the results obtained in the analysis and their interpretation, the following conclusions could be stated:

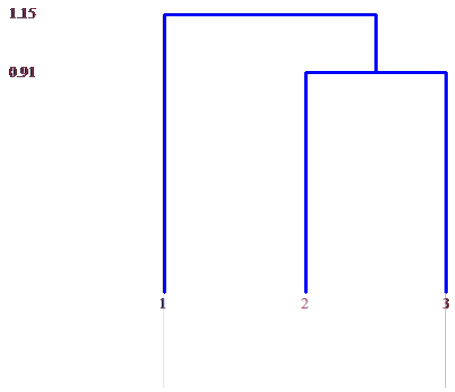
Evaluating ***motor development*** in Special elementary and secondary school participants, using MANOVA (.002) and DISCRA (.002) analysis, statistically significant differences are estimated among 3 sub-categories of ***IQ maturity,*** related to the (PFT) variables.

Evaluating ***motor development*** in Special elementary and secondary school participants, using MANOVA (.001) and DISCRA (.001) analysis, statistically significant ***gender difference*** exists between 2 sub-samples (Male/Female), related to the (PFT) variables.

Evaluating ***motor development*** in Special elementary and secondary school participants, using MANOVA (.000) and DISCRA (.000) analysis, statistically significant ***grade-level*** differences exist among 4 groups (grades/classes), related to the (PFT) variables.

As the alternative hypothesis A_1, A_2, and A_3 were confirmed in majority of cases, the respective estimated differences and clearly defined borders were determined characteristics and homogeneity of every sub-sample.

General conclusion, derived from results of this study, provided within Special Education Students in upper level of Elementary, and Secondary School children do not support a link between Physical Fitness Test and common indices of academic achievement, such as average of various educational subjects' marks (grade-points).



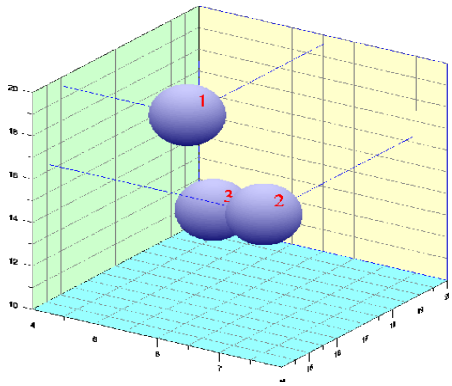
Legend: IQ maturity: (48-54) **(1);** IQ (55-70) **(2);** IQ (71-109) **(3)**

The significant relationship was estimated between chronological age and educational performance (at 0.5* level), and between IQ-maturity and educational

performance (at 0.1* level) with Kendall's (.416) and Spearman's (.537) Correlation coefficient.

Physical Fitness Tests (PFT) items scores were transformed into standardized *z*-score, and have not established significant correlation with other variables within total sample of participants.

Graph 1. Three dimensional presentation of the distance/closeness of the different IQ maturity sub-categories of participants evaluated with 9-item Physical Fitness Test (PFT)



Legend: IQ maturity: (48-54) **(1);** IQ (55-70) **(2);** IQ (71-109) **(3)**

Referencess*

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Complete List** of ***References is on disposal complimentary, by copy request to the leading author

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Note:

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