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Original Aspects Regarding the Motor Age of Students in Primary Education

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Abstract

As in the other aspects of social life, the field of physical education is an important vector of concerns aimed at optimizing it under all its aspects. The prepubertal period, which is associated with primary education, is particularly important in the development and maturation process of the individual, considering that, up to the age of 10 years, children acquire over 80% of their lifetime motor experience. Therefore, investigating the internal mechanisms specific to the motor and psychomotor organization of students in vocational primary education to optimize their instructive-educational process is the main objective of this experimental research. The experiment involved 20 students in grades 1-4 from the "Bălașa Doamna" High School of Fine Arts in Târgoviște. They were assessed on the sports ground and in the sports hall of the above-mentioned high school. The assessment consisted in applying 12 items specific to the Bilateral Coordination and Running Speed and Agility subtests from the Bruininks-Oseretsky Test Battery, Second Edition. The results highlighted a series of information about the motor age of the investigated subjects, as compared to their chronological age, for the Running Speed and Agility and Bilateral Coordination components. All this information, coupled with the study of theoretical and methodological aspects specific to this level of education, is a basic element of the learning strategy that any person directly involved in the instructive-educational process should adopt and adapt to current educational requirements.

Keywords: Vocational Primary Education, Bilateral Coordination, Running Speed & Agility, Motor Age, Chronological Age.

Introduction

As in the other aspects of social life, the field of physical education is an important vector of concerns aimed at optimizing it under all its aspects. This implies the development of strategies objectified at the national, regional, or institutional level and their implementation to improve the educational path of direct beneficiaries – students [1]. Physical education remains an effective and indispensable means of general education regarded whether we talk about reviewing its objectives and specific contents in accordance with modern requirements or about its influence on the instructive-educational process [2]. Physical education should focus on the acquisition of sequential motor skills and "increased physical competency based on the unique developmental level of the individual" [3]. Issues related to the motor age of students in vocational primary education are included into the sphere of psychomotor development of the individual, a particularly important topic for the theories and models specific to human behaviour. Psychomotor development refers to changes in a child's cognitive, emotional, motor, and social abilities from the beginning of life throughout fetal and neonatal periods, infancy, childhood, and adolescence. "It occurs in a variety of domains and a wide range of theories makes understanding children's development a challenging undertaking" [4].

Psychomotricity is a relatively new concept in the field of physical education and sport. Since the transition to physical education as a school subject taught by specialized teachers, the trend has imposed the creation and adaptation of means applied to older students, but equally to preschool and primary school students. This tendency also exists in sports, where the initiation process has lowered to younger age levels. Given this situation, the necessity to respond to children's real needs has emerged [5].

Of major importance for the field of physical education and not only, psychomotricity offers, by systematically and properly addressing its components, the favorable framework for the effective adaptation of the child to the requirements of school and social environments [6]. During childhood, individuals interact with their environments through direct and indirect actions that

foster their development [7]. The development of various gross and fine motor skills begins in infancy and, throughout childhood, individuals experience tremendous physical and developmental growth that typically progresses in a predictable sequence [8]. Therefore, the fundamental concern in the current educational context is represented by the early identification of possible gaps in the psychomotor development of children through several specific assessments aimed to achieve the individualized and differentiated planning of the educational approach [9].

Assessing motor skills by using an appropriate tool for the diagnosis and assessment of motor proficiency age is an essential objective that every teacher should have, mostly in preschool- age children [10], but also throughout primary education. The BOT-2 test is a norm-referenced test whose most important reason for implementation is to assess motor proficiency in children and adolescents, as well as to use it in the screening process [11]. This test is applicable and purpose-oriented and is used to measure motor skills in individuals aged 4 to 21 years. It is often used by therapists and paediatricians specializing in motor disorders, as well as by sports teachers to evaluate motor development and diagnose developmental coordination disorders (DCD) in children from different countries [12].

Research purpose

Individual appropriateness, the key concept of developmental physical education, is based on the central idea that each child has a unique timing and pattern of growth and development. Therefore, motor activities performed by children engaged in developmental physical education programmed "are geared to their stage of motor development and level of skill learning" [3]. The prepubertal period, which is associated with primary education, is particularly important in the development and maturation process of the individual, considering that, up to the age of 10, children acquire over 80% of their lifetime motor experience. Thus, investigating the internal mechanisms specific to the motor and psychomotor organization of students in vocational primary education to optimize their instructive-educational process is the main objective of this experimental research.

Hypothesis

The results obtained after assessing the research subjects through the Bruininks-Oseretsky Test Battery, Second Edition, will highlight the existence of statistically significant differences between the arithmetic means of motor age and chronological age, as revealed by the Bilateral Coordination and Running Speed and Agility subtests.

Methodology

Research design and subjects

This ascertaining psycho-pedagogical experiment is part of the doctoral thesis of the first author and was conducted on 20 students in grades 1-4 from the "Bălaşa Doamna" High School of Fine Arts in Târgovişte. The research subjects were assessed on the sports ground and in the sports hall of the above-mentioned high school between 28 April and 9 May 2014. The assessment consisted in applying 12 items specific to Bilateral Coordination and Running Speed and Agility subtests from the Bruininks-Oseretsky Test Battery, Second Edition. The IT products and specific tools used for the statistical analysis of the obtained results were mainly represented by BOT-2 ASSISTTM, the Scoring and Reporting System (specific software of the Bruininks-Oseretsky Test Battery, Second Edition, which was used to process and interpret the raw scores obtained by students in the subtests performed, and then convert them into derived scores characteristic of each subject – scale score, standard score, confidence interval, percentile rank, age equivalent, descriptive category), as well as MINITAB, version 15.1, of the MINITAB Inc. (a computer product designed to process the statistical data characterizing the main entities of a phenomenon subjected to statistical analysis in order to understand it).

Description of subtests

According to Matheis and Estabillo [7], there are several "standardized measures that assess motor functioning in children, including those specifically examining fine and/or gross motor skills, measures of developmental functioning and informant report-based interviews and questionnaires". As an assessment tool, we used the improved version of the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2), namely a set of individually administered tests with very precise and well-targeted objectives aimed to measure a wide range of motor skills in subjects aged 4-21 years. This test was designed to be used, among others, by physical therapists, psychologists, physical education teachers and coaches, providing them with an effective instrument for measuring fine and gross motor skills. The subtests and corresponding composites that assess manual coordination, body coordination and strength and agility skills will be especially informative for developmental adaptive physical education teachers and physical therapists, while the subtests and corresponding composites that assess fine manual control skills will be particularly valuable to occupational therapists, special educators, classroom teachers and rehabilitation specialists. BOT-2 assesses abilities from four different motor areas [13].

- Fine Manual Control: Subtest 1 – Fine Motor Precision; Subtest 2 – Fine Motor Integration.
- Manual Coordination: Subtest 3 – Manual Dexterity; Subtest 7 – Upper Limb Coordination.
- Body Coordination: Subtest 4 – Bilateral Coordination; Subtest 5 – Balance.
- Strength and Agility: Subtest 6 – Running Speed and Agility; Subtest 8 – Strength.

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For this research, out of the eight subtests specific to the motor areas described above, we have chosen the Bilateral Coordination and Running Speed and Agility subtests. Defined in the literature as "the ability to coordinate both sides of the body at the same time in an organized and controlled manner" [14], bilateral coordination is a basic component of psychomotor behaviour, which directly influences the successful performance of various types of motor actions and activities carried out in everyday life or specific to certain branches of sport. Activities from the Running Speed and Agility subtest, whether if we talk about shuttle run, hopping on one or both feet, or stepping over a balance beam, provides the opportunity to make educational and even clinical observations about child's performance. The aspects described above highlight once again that the psychomotor assessment of these components should be mainly performed at certain stages of child development in ontogenesis, when the specialized intervention, because of identifying normal or pathological gaps in the psychomotor development of the child, has maximum chances of success.

Subtest 4: Bilateral Coordination

Content:

Item 1: Touching Nose with Index Fingers - Eyes Closed.

Item 2: Jumping Jacks.

Item 3: Jumping in Place - Same Sides Synchronized.

Item 4: Jumping in Place - Opposite Sides Synchronized.

Item 5: Pivoting Thumbs and Index Fingers.

Item 6: Tapping Feet and Fingers - Same Sides Synchronized.

Item 7: Tapping Feet and Fingers - Opposite Sides.

Subtest 5: Running Speed and Agility

Content:

Item 1: Shuttle Run.

Item 2: Stepping Sideways over a Balance Beam.

Item 3: One-Legged Stationary Hop.

Item 4: One-Legged Side Hop.

Item 5: Two-Legged Side Hop.

Statistical processing of results

The research results were statistically processed using the following IT products:

1) BOT-2 ASSISTTM, Scoring and Reporting System: specific software of the Bruininks-Oseretsky Test Battery, Second Edition.

2) MINITAB, version 15.1, of the MINITAB Inc., a computer product designed to process the statistical data characterizing the main entities of a phenomenon subjected to statistical analysis to understand it.

In our research, we used the following instruments provided by this IT product:

- Statistical indicators of central tendency (arithmetic mean, median, mode).
- Statistical indicators of data spreading (standard deviation, dispersion, maximum and minimum values, range, coefficient of variation).
- The two-tailed dependent t-test – to verify the statistical hypothesis regarding the existence of statistical differences between the arithmetic means of motor age and chronological age for the measured parameters.

3) The Microsoft EXCEL 2003 product, which was used to:

- Calculate the Cohen's effect size index and the percentage value of the difference between the average scores recorded by students.
- Make the necessary adjacent calculations (totals, mean differences, percentages, data ordering, filtering).
- Statistically interpret the test results for each of the analysed parameters.

Results

Table 1 shows the results achieved by students in the Bilateral Coordination and Running Speed and Agility subtests, as well as the statistical interpretation of the specific values for each subtest. Statistical data processing highlights the following aspects specific to the two components addressed (Bilateral Coordination and Running Speed and Agility): In the Bilateral Coordination test, the average motor age is 9.83 (9:10) years compared to 7.53 (7:6), which is the average chronological age. We find that the average motor age is 2.30 (2:4) years higher than the average chronological age. Data spreading is homogeneous for chronological age and relatively homogeneous for motor age. The most common result for motor age is 8.58 (8:7) years, with a percentage of 40% of total results. The effect size (1.61) indicates large-to-very large differences between the two ages.

The ages recorded for Bilateral Coordination are graphically represented in Figure 1. In the Running Speed and Agility subtest, the average motor age is 9.82 (9:10) years. We note that the average motor age is 2.29 (2:3) years higher than the average chronological age. Data spreading is relatively homogenous for motor age and homogeneous for chronological age. The most common motor age is 9.33 (9:4) years, with a percentage of 30% of total results. The effect size (3.84) indicates large to very large differences between the two ages. The ages recorded for Running Speed and Agility subtest are graphically represented in Figure 2.

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Table 1: Results achieved by students in the Bilateral Coordination and Running Speed and Agility subtests and their statistical interpretation.

	Bilateral Coordination		Running Speed and Agility	
Statistical indicators	Chronological age	Motor age	Chronological age	Motor age
Arithmetic mean	7:06	9:10	7:06	9:10
Median	7:06	9:04	7:06	9:07
Standard deviation		1:06	0:03	0:09
Mode	7:03	8:07	7:03	9:04
Maximum	8:03	12:03	8:03	11:01
Minimum	7:02	7:10	7:02	8:07
Range	1:01	4:05	1:01	2:06
Coefficient of variation (%)	3.90%	15.40%	3.90%	7.40%
Two-Tailed Dependent t-Test				
Difference between chronological age and motor age				
Mean	2:4		2:3	
Median	1:9		2:1	
Standard deviation	1:5		0:7	
Critical t-value	2.093		2.093	
Calculated t-value	7.218		17.19	
p << 0.0001	p << 0.0001		p << 0.0001	
Effect size	1.61		3.84	

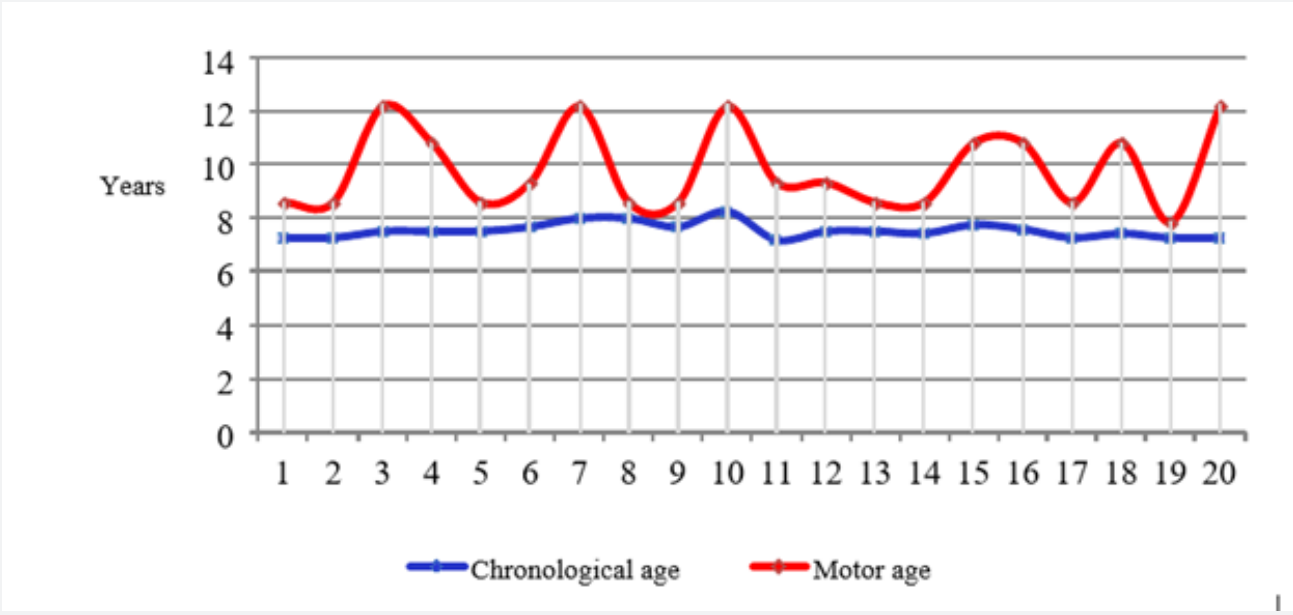

Figure 1: Chronological age and motor age in the Bilateral Coordination subtest.

Discussions

Present as a specific objective for the field of physical education, the development of psychomotor skills ensures, through its fulfillment, the completion of the acquisitions specific to the different stages of learning in the child's life. It follows that insufficient approach to these issues, especially in their relationship with other variables of the educational process, can lead to an incomplete and distorted picture of the efficiency

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of programming and evaluation of teaching content and results, transposed into behavior specific to this age stage. The results of this research highlight the importance of adapting and optimizing the methodology of applying the physical education program at the primary cycle, depending on the particularities of psychomotor development of students, especially at the direct relationship between motor and chronological age. For the field of physical education, knowing the level of psychomotor development of the child is both an objective present in each stage of study and the starting point in developing intervention strategies characteristic of educational cycles, beginning from the content of the study program and ending with the formulation of the operational objectives of each lesson. In the absence of this valuable information, the teacher is put in the situation to approach the instructive-educational process in an empirical way, without the feedback of the students he works with, which is unacceptable in the conditions of a modern and efficient education [6].

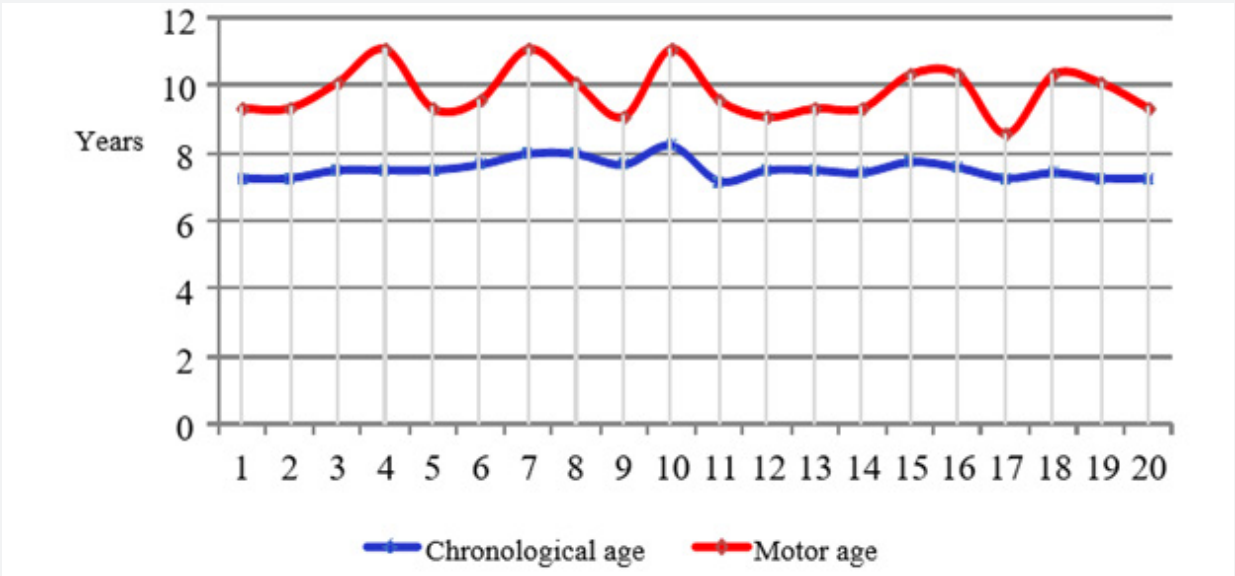

Figure 2: Chronological age and motor age in the Running Speed and Agility Subtest.

Knowledge and understanding of the internal mechanisms that influence the appearance of differences between motor age and chronological age of primary vocational students, using objective and modern means of assessment, is the starting point in developing individualized teaching and training strategies which considers both the educational profile of the student and the stage of his ontogenetic development. Moreover, the results of this research open the horizon of orientations to other age stages in which specialized intervention is urgently needed, both in terms of training and in terms of diagnosing certain gaps in the field of psychomotor development of the child. We refer here to the preschool period and to the one of the gymnasium cycles of studies, periods at the level of which the most important psycho-behavioral acquisitions are made. We also consider it opportune to initiate further research, covering various aspects related to the psychomotor development of primary and primary vocational students and whose results allow the formulation of valid conclusions at regional and even national level.

Conclusion

After testing the group of subjects to verify the existence of statistically significant differences between the arithmetic means of chronological age and motor age for the Bilateral Coordination and Running Speed and Agility parameters, we can draw the following conclusions: As regards the Bilateral Coordination component, the statistical hypothesis verification using the two-tailed dependent t-test for equal means has shown that there are statistically significant differences between the two average ages, $p << 0.0001 < 0.05$. Therefore, the research hypothesis according to which the difference between chronological age and motor age is statistically significant is confirmed.

For the Running Speed and Agility parameter, the statistical hypothesis verification using the two-tailed dependent t-test for equal means has shown that there are statistically significant differences between the two average ages, $p << 0.0001 < 0.05$. Thus, the null hypothesis is rejected and the research hypothesis according to which the difference between chronological age and motor age is statistically significant is accepted. Physical education mainly aims to educate and develop fine and gross motor skills, generally with an intentional purpose, thus providing the necessary conditions to reach a high level of motor behaviour (a prerequisite for motor performance), with applicability in various fields of social practice.

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Motor development is directly related to the development of cognitive, language and social skills. The assessment of motor skills and functioning in children provides valuable information towards the screening of developmental delays, the identification of neuro-developmental disorders, intervention planning and progress monitoring [7]. Physical education should encourage the uniqueness of the individual and should be based on the fundamental idea that, although motor development is aged-related, it is not age-dependent. As a result, teacher decisions concerning what to teach, when to teach it and how to teach are primarily based on the appropriateness of the activity for the individual and only secondarily on the appropriateness of the activity for a certain age group [3]. In an earlier time, the psychomotricity integrated into school physical education was assimilated only as an instrument of motor development. At the same time, school physical education recognizes the human person as a subject, with complex emotions and own shares. The relationship between physical education and psychomotricity originates in the human being's desire for relating to and integrating into the environment, which can be achieved through conscious actions and movements, through experiencing at every stage of life [15].

The research results highlighted a series of information about the motor age of the investigated subjects, as compared to their chronological age, for the Running Speed and Agility and Bilateral Coordination components. All this information, coupled with the study of theoretical and methodological aspects specific to this level of education, is a basic element of the learning strategy that any person directly involved in the instructive-educational process should adopt and adapt to current educational requirements. Assessment, in whatever form and context, is an essential link of the educational process, which involves the constant adaptation of its content to current requirements related to the curriculum and the concrete ways of applying it according to each educational level. When selecting an appropriate measure, attention should be paid to child characteristics and the purpose of the assessment. As part of a comprehensive assessment, standardized measures should be paired with parent/caregiver interview and clinical examination of cognitive, adaptive, and physical functioning [7]. Therefore, the modern means of assessment, for example the Bruininks-Oseretsky Test Battery, Second Edition, as instruments for validating the results of experimental research like the present one, continue to prove their usefulness and effectiveness in terms of objectivity, but especially from the perspective of the multiple aspects targeted and highlighted [16-19].

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