https://doi.org/10.7251/SSH2302167S
UDC: 378.1:005.346]:611.1/.8
Original scientific paper
Originalni naučni rad

Motor abilities of students with specific learning disabilities and a student of regular development

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Abstract: *The timely development of motor abilities contributes to the overall development of students, but due to various potential problems, there are often deviations that can affect the quality of daily movement. The aim of the research was to assess the motor abilities of primary education students, and to determine significant differences in individual motor abilities with regard to the existence of a particular learning difficulty or not. The research was conducted on a sample of 101 students (47 students aged 9 years ± 6 months and 54 students aged 10 years ± 6 months). Standardized tests were applied to assess motor abilities: repetitive strength, coordination, speed, explosive power of jumping, agility, flexibility and balance. The basic descriptive indicators were calculated, and the t-test for independent samples was used to determine the significance of differences in motor abilities with regard to the existence of specific learning difficulties. Results: Of the total sample, 75.25% were students without learning disabilities, and 24.75% with specific learning disabilities. Students with no established learning difficulties achieved significantly better results in the variables that assess flexibility (AS1=60.43±18.90 vs.AS2=52.59±12.93; t=1.99; p=0.05), balance (AS1=114.51±107.29 vs. AS2=68.04±75.62; t=2.07; p=0.04), explosive jumping power (AS1=147.09±23.24 vs. AS2=134.15±20.17; t=2.57; p=0.01) and coordination (AS1=20.11±8.78 vs. AS2=26.97±11.84; t=-3.17; p=0.00) from students with specific learning difficulties. Conclusion: Students with specific learning difficulties have less developed individual motor abilities than students with normal development, which encourages thinking about whether it is necessary to adjust the evaluation criteria to their abilities.*
Keywords: *motor abilities, students, specific learning disabilities.*

INTRODUCTION

Many students in their first years of schooling have potential problems that affect their learning ability and overall success in school. The problems that stand out are related to reading, delayed writing skills and/or deficits in math. These are specific learning difficulties which, according to the set of skills in the school area, are grouped into dyslexia (greater difficulties in mastering reading skills), dysgraphia (greater difficulties in mastering writing) and dyscalculia (greater difficulties in learning mathematics) (Bouillet, 2010). The National Center for Learning Disabilities (2014) states that learning disabilities result from neurological differences in the structure and function of the brain and affect a person's ability to receive, store, process, download or communicate information. The stated learning difficulties may be temporary and can be corrected with appropriate interventions, but in 5% to 15% of students the stated difficulties may remain permanent and significant, despite appropriate interventions (American Psychiatric Association, 1994). In addition to learning difficulties, students often encounter other accompanying problems, such as disorientation in space, difficulty determining left and right sides, and poor concentration (Kiš-Glavaš, 2016), which, among other things, is reflected in poorer performance of motor tasks, and weaker development of motor abilities. Motor abilities can be defined as a person's potential in performing simple or complex voluntary movements that are performed by skeletal muscle action (Sekulić and Metikoš, 2007). They are part of the kinanthropological characteristics that significantly change and progress during the period of primary education under the influence of kinesiology activities.

Some research has revealed that students with specific learning disabilities may have less developed motor abilities (Getchell, Pabreja, Neeld & Carrio, 2007; Blanchet & Assaiante, 2022), which is particularly reflected in the implementation of more complex motor tasks. For example, students with dysgraphia and dyscalculia are often accompanied by dyspraxia, which can be explained as a developmental disorder in the planning and execution of motor actions (Kemp, Smith and Segal, 2017), and is manifested first of all by difficulties in fine and gross motor skills,

then by difficulties in maintaining static and dynamic balance and difficulties in coordinated manipulation of objects (Minnis, 2017; Abdulkarim, 2018). Students with dyspraxia are characterized by clumsiness when performing complex movements, they have too pronounced movements, they tire quickly, and there may be difficulties in activities that include playing with a ball caused by poor hand-eye coordination (Minnis, 2017; Kemp, Smith and Segal, 2017).

The aim of this research is to assess the motor abilities of primary education students, and to determine the significance of the difference in individual motor abilities with regard to the existence of a particular learning difficulty or not.

METHODS

Study participants

The research was conducted on a sample of 101 primary education students (47 students aged 9 years ± 6 months and 54 students aged 10 years ± 6 months) who voluntarily participated in the research, and for whom parental consent was obtained. The students do not have any motor aberrations, and the randomly selected sample also includes students who have one or more specific learning difficulties, and who are included in the regular education system. Out of the total sample of respondents, 76 (75.25%) are students without learning difficulties, and 25 students (24.75%) are with specific learning difficulties, of which 7 students have been diagnosed with dyslexia and dysgraphia, 6 students have only been diagnosed with dyslexia , 3 students have dysgraphia, and three students have speech difficulties with dyslexia and dysgraphia. There are two students with attention deficit disorder with dyslexia and dysgraphia, there are also two students with language difficulties and learning difficulties. One is a student with learning disabilities and epilepsy and 1 is a student with speech difficulties and dysgraphia (Figure 1).

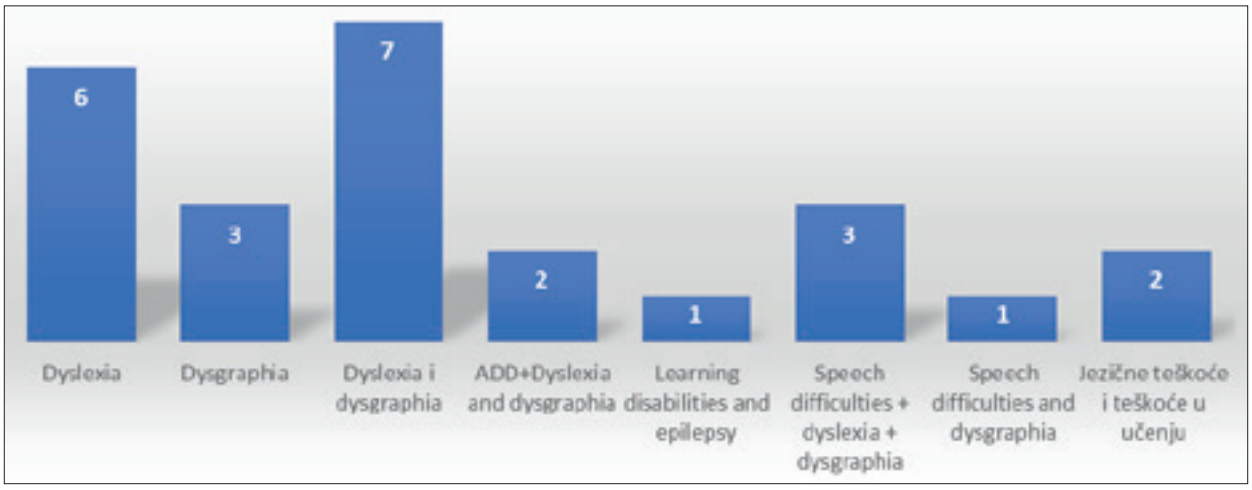


Figure 1. *Share of students with specific learning difficulties according to their diagnoses*

Variables

Standardized tests were used to assess students' motor abilities, which were regularly applied at school with the aim of monitoring students' motor progress. These were tests for evaluating repetitive strength (Sit ups - MRSPTL), coordination (Backward polygon - MREPOL), speed (Plate tapping test - MBFTAP), explosive power of jumping (Standing broad jump - MFESDM), agility (Transferring a sponge by running from side to side -MAGPRP), flexibility (Sit and reach test - MPR) and balance (Balance test on one leg - MFLB).

Statistical analisis

For the purpose of the research, the following descriptive indicators were calculated: arithmetic mean (mean), standard deviation (std. dev.), central value (median), minimum value (minumum), maximum value (maximum), measure of skewness and measure flattening of the distribution (kurtosis). The normality of the distribution was tested with the Kolmogorov-Smirnov test. Since most of the distributions did not deviate significantly from normality, the t-test for independent samples was used to determine the significance of differences in motor abilities with regard to the existence of specific learning difficulties.

RESULTS

Out of the total sample of respondents, 25 students (25%) have specific learning difficulties (12 female students and 13 male students), and 76 students (75%) are of regular development (42 female students and 34 male students) (Figure 2).

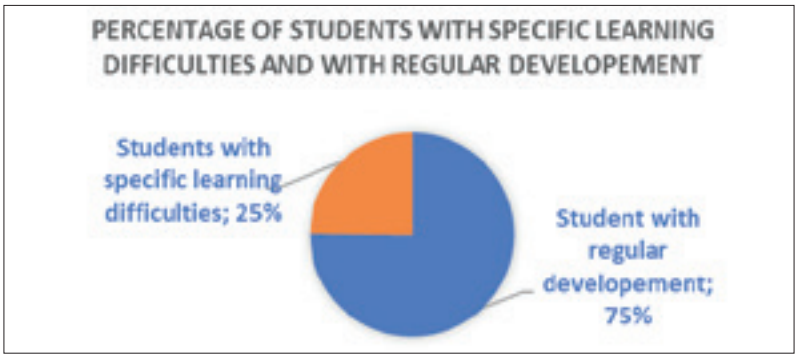


Figure 2. *Percentage of students with specific learning difficulties and students with regular development*

Basic descriptive indicators of motor tests on subsamples were calculated with regard to the presence and absence of specific learning difficulties. Table 1 shows the values of arithmetic means, standard deviations, median, minimum and maximum scores, and measures of curvature and flatness of distributions. Also presented are the results of the Kolmogorov-Smirnov test for assessing the normality of the distribution (Max D and K-S) separately on subsamples with regard to the presence and absence of specific learning disabilities. Comparing the values of the arithmetic means of the measured sample, it is evident that students without specific learning difficulties achieve better results in all motor tests. The greatest dispersion of results is in the Balance test on one leg and Standing broad jump variables. How big the dispersion of the results is is indicated by the values of the minimum and maximum results for both groups of respondents. The Kolmogorov-Smirn test showed that the distributions of the variables Balance test on one leg and Transferring the sponge by running from side to side significantly deviate from normality, while the distributions of the other variables do not deviate. For further processing, the t-test for independent samples was applied.

Table 1. *Descriptive indicators of motor test subjects on subsamples without and with specific learning difficulties (SLD)*

STUDENTS WITHOUT SLD N=76	Mean	SD	MED	MIN	MAX	SKEW	KURT	Max D	K-S test
Sit and reach test (cm)	60.43	18.90	57.50	26.00	105.00	0.36	-0.38	0.09	p > .20
Balance test on one leg (s)	114.51	107.29	88.50	10.00	600.00	2.68	9.62	0.17	p < .05*
Plate tapping test (s)	20.36	2.31	20.00	16.00	26.00	0.19	-0.50	0.11	p > .20
Standing broad jump (cm)	147.09	23.24	145.00	80.00	194.00	-0.43	0.18	0.08	p > .20
Backward polygon (s)	20.11	8.78	18.68	8.06	53.36	1.57	2.86	0.14	p < .10
Transferring the sponge by running from side to side (s)	13.16	2.68	12.20	10.24	24.32	1.73	3.50	0.23	p < .01*
Sit ups (min)	33.26	7.67	35.00	17.00	46.00	-0.51	-0.65	0.12	p > .20
STUDENTS WITH SLD N= 25	**AS**	**SD**	**MED**	**MIN**	**MAX**	**SKEW**	**KURT**	**Max D**	**K-S test**
Sit and reach test (cm)	52.59	12.93	51.00	28.00	80.00	0.14	-0.75	0.11	p > .20
Balance test on one leg (s)	68.04	75.62	52.00	8.00	412.00	3.85	17.49	0.30	p < .01*
Plate tapping test (s)	19.74	5.47	20.00	6.00	37.00	0.93	4.36	0.20	p < .15
Standing broad jump (cm)	134.15	20.17	138.00	77.00	160.00	-1.11	1.10	0.16	p > .20
Backward polygon (s)	26.97	11.84	22.87	16.84	79.00	3.55	14.89	0.28	p < .05*
Transferring the sponge by running from side to side (s)	13.20	2.80	12.19	10.24	19.00	1.19	-0.20	0.33	p < .01*
Sit ups (min)	30.56	8.47	34.00	10.00	40.00	-1.06	0.27	0.18	p > .20

Legend (N- number of students, AS-arithmetic mean, SD- standard deviation, Med- central value, Min- minimum value, MAX- maximum value, Skew- measure of curvature of distribution, Kurt- measure of flatness of distribution)

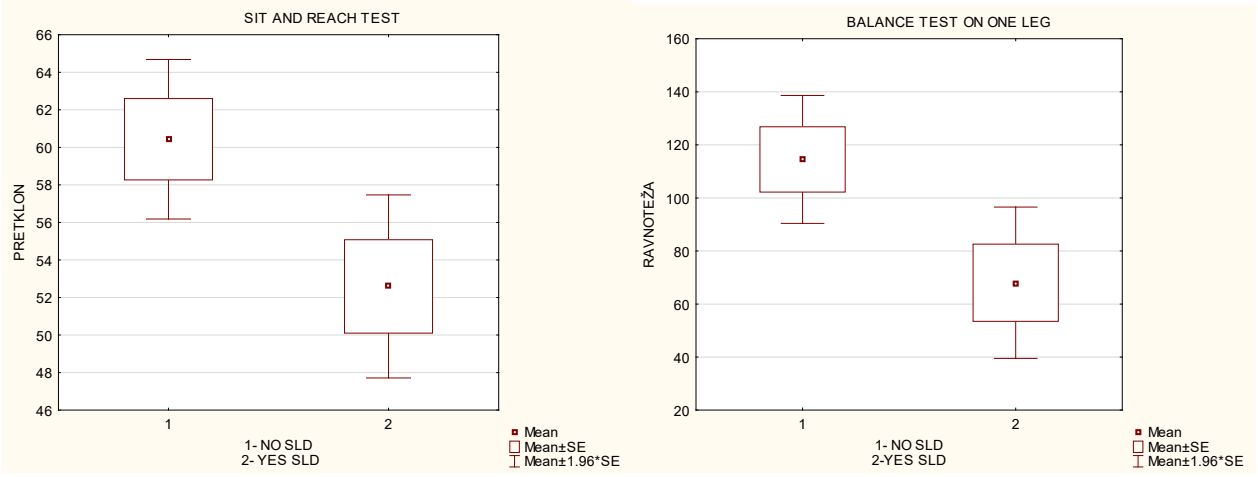
In order to determine the significance of the differences in students' motor abilities with regard to the presence and absence of specific learning difficulties, the t-test for independent samples was applied. Students differ significantly in 4 out of 8 measured variables. More precisely, a statistically significant difference was obtained in the variables *Sit and reach test, Balance test on one leg, Standing broad jump and Backward polygon*. According to the obtained results, students who have no established learning difficulties achieved significantly better results with variables that assess flexibility (Mean1=60.43 ± 18.90 vs.Mean2=52.59 ± 12.93; t=1.99; p= 0.05), balance (Mean1=114.51 ± 107.29 vs. Mean2=68.04 ± 75.62; t=2.07; p=0.04), explosive jumping power (Mean1=147.09 ± 23.24 vs. Mean2= 134.15 ± 20.17; t=2.57; p=0.01) and coordination (Mean1=20.11 ± 8.78 vs. Mean2=26.97 ± 11.84; t=-3.17; p=0.00). In the other motor tests, *Plate tapping test, Transferring the sponge by running from side to side, and Sit and reach test*, students with normal development achieved slightly better results, but not enough to establish statistical significance.

Table 2. *Differences in individual motor tests with regard to the existence of specific learning difficulties (SLD) and without specific learning difficulties (SLD)*

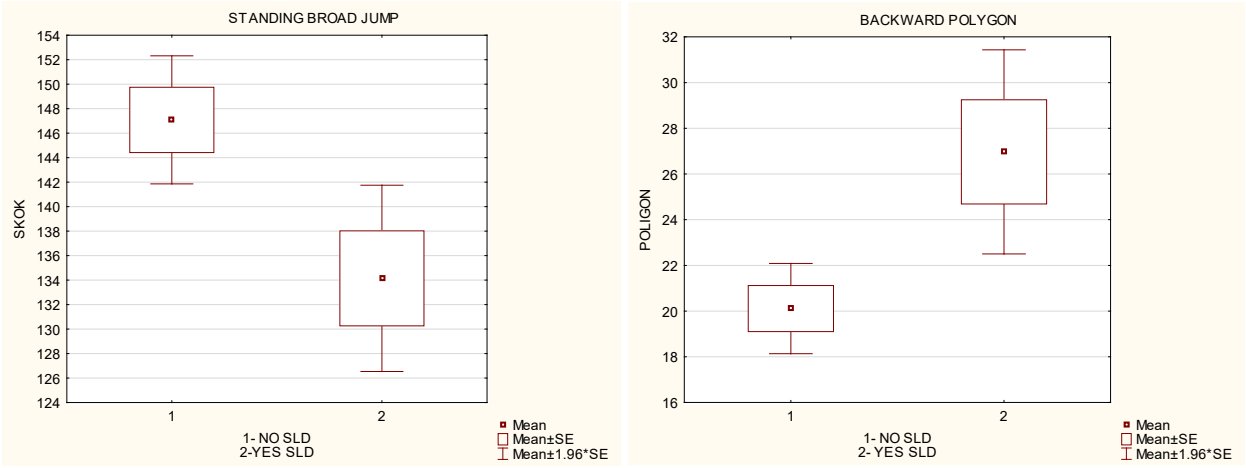
	Mean 1- of students without SLD N=76	Mean 2- of students with SLD N=25	t-value	df	p
Sit and reach test (cm)	60.43	52.59	1.99	101	0,05*
Balance test on one leg (s)	114.51	68.04	2.07	101	0,04*
Plate tapping test (s)	20.36	19.74	0.80	101	0,42
Standing broad jump (cm)	147.09	134.15	2.57	101	0,01*
Backward polygon (s)	20.11	26.97	-3.17	101	0,00*
Transferring the sponge by running from side to side (s)	13.16	13.20	-0.06	101	0,95
Sit ups (min)	33.26	30.56	1.53	101	0,13

Legend: N- number; Mean- arithmetic mean; t-value; df- degrees of freedom; p- level of significance

What is the difference in the results of the variables that proved to be statistically significant, can best be seen in graphs 1, 2, 3 and 4.



Graph 1 and 2. *Presentation of the significance of the differences in the variables Sit and reach test, (flexibility) and Balance test on one leg (balance)*



Graph 3 and 4. *Presentation of the significance of the differences in the variables Standing broad jump (explosive power of jumping) and Backward polygon (coordination)*

DISCUSSION

The values of the arithmetic means of the measured sample indicate that, in comparison with the normative values according to age, students achieve average results in all motor tests (Findak, Metikoš, Mraković, Neljak, 1996; Vidranski, 2020; Tomkinson, et al. 2018). Unfortunately, numerous population studies indicate a decline in motor abilities (Eberhardt, Niessner, Oriwol, Buchal, Worth, & Bös, 2020; Fühner, Kliegl, Arntz, Kriemler, & Granacher, 2021). The vast majority of studies show a steady decline in strength and endurance, and as for agility, speed, balance and coordination, the trend differs between populations (Masanovic et al. 2020). The reasons for the decline of motor abilities can be various, and the most prominent is the modern way of life in which sedentary activities become dominant and physical activity is less and less present. In students with specific learning difficulties, motor changes can occur due to numerous environmental factors that contribute to the delay in the development of the central nervous system and its executive functions, increasing the likelihood of deficiencies in motor development (Coppede, Okuda and Capellini, 2012). Numerous studies indicate that students with specific learning disabilities have less developed motor abilities than their peers (Blanchet & Assaiante, 2022; Okuda, Pinheiro, 2015). And in this research, in all motor tests, students with specific learning difficulties achieve worse results from students with regular development, and in the tests *Sit and reach test, Balance test on one leg, Standing broad jump and Backward polygon*, the differences were statistically significant. Students with specific learning difficulties have less developed flexibility, balance, explosive jumping power and coordination. In the research of Okuda and Pinheiro (2015), the authors observed similar results. In their research, students with specific learning disabilities have significantly less developed fine motor integration, balance, running speed and agility.

Observation of gross motor composites in the study by Hussein, Abdel-Aty, Elmeniawy and Mahgoub (2020) showed that 80% of children with specific learning disabilities are below average in terms of bilateral coordination, 58% below average in terms of balance, 74% below average in running speed and agility, and 68% below average in terms of strength. Some authors indicate that deviations from the average vary with age. For example, a longitudinal study by Westendorp et al. (2011) revealed that children with specific learning disabilities achieved significantly lower results in all motor tests between the ages of 7 and 11, but the difference between the groups changed with age. In that research, a big difference in ball skills between both groups was particularly highlighted, which was more pronounced at the age of 7, and later at the age of 11, the difference between the groups decreased. The authors came to the conclusion that children with specific learning difficulties develop ball skills later in the elementary school period compared to their peers.

Deviations in individual motor abilities are partially differentiated with regard to specific learning difficulties. Students diagnosed with dyslexia most often have less developed coordination, especially of the upper extremities, fine motor skills, strength and agility (Westendorp et al. 2014), as well as static balance (Okuda, Ramos, Santos, Padula, Kirby, Capellini, 2014), while in manipulation objects, especially with a ball, there are almost no deviations (Iversen, Berg, Ellertsen, Tønnessen, 2005). Even in activities that require a fast frequency of movements, despi-

te less developed manual coordination, no significant differences were observed in students with dyslexia (Marchand-Krynski, Morin-Moncet, Bélanger, Beauchamp, Leonard, 2017), which is similar to the results of this study. Students diagnosed with dyscalculia usually have less developed bilateral coordination as well as running speed and agility (Hussein et al. 2020; Smits-Engelsman, Wilson, Westenberg, Duysens, 2003).

As Westendorp et al. (2011) claim, the greater the delay in children's learning, the worse the results of their motor skills, and they emphasize the importance of specific interventions that facilitate both motor and academic abilities. Although there are deviations in the progress of individual motor abilities, students with specific learning difficulties should be encouraged to engage in activities and perform movements correctly. If the child is physically active enough since childhood, this can only have a positive effect on his overall motor development, and on the contrary, if children with learning difficulties distance themselves from such content, it can have an extremely negative effect on them.

CONCLUSON

The research indicates the existence of significant differences in individual motor abilities of students with normal development and students with specific learning difficulties. Students with specific learning disabilities have significantly less developed flexibility, balance, explosive jumping power and coordination. Although students with specific learning difficulties may find it difficult to perform certain complex motor actions, despite the prominent problem, they should be encouraged to engage in such activities. It is necessary to make them aware of how important movement is for their motor development, and how regular physical exercise contributes to the development of their skills and competencies. The results of the conducted research certainly encouraged thinking about how the achievements in certain motor tasks of students with specific learning difficulties should be evaluated, that is, whether the evaluation criteria should be adapted to their abilities. Also, in future assessments of the motor abilities of students with developmental disabilities, it is necessary to include other parameters that can impair motor development, such as the level of physical activity, the prevalence of sedentary activities, and the frequency of participation in organized extracurricular sports activities.

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Primljen: 18. oktobar 2023. / Received: October 18, 2023
Prihvaćen: 03. decembar 2023. / Accepted: December 03, 2023