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THE INFLUENCE OF THE INDIVIDUAL EDUCATIONAL-REHABILITATION PROGRAM ON THE MOTOR COORDINATION OF STUDENTS WITH VISUAL IMPAIRMENT

UTICAJ INDIDIVIDUALNOG EDUKACIJSKO-REHABILITACIJSKOG PROGRAMA NA MOTORIČKU KOORDINACIJU UČENIKA S OŠTEĆENJEM VIDA

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Case Study

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ABSTRACT

The motor development of the child, especially motor coordination, is important for performing purposeful activities. The aim of this study was to determine the impact of individual educational and rehabilitation treatment on motor coordination in students with visual impairment. The sample included one student, male, aged 9 years, with a diagnosis of nystagmus, amblyopia and astigmatism. The initial and final assessment was done with the student, and the Beery-Buktenica developmental test of visual-motor integration (VMI) fifth edition was used for the same, which is intended for the assessment of visual-motor integration, visual perception and motor coordination. For the purposes of this research, the subtest *Motor Coordination* was used, which consists of 30 tasks. After the initial assessment, an individual educational-rehabilitation treatment lasting 2 months was conducted. Survey data was processed by frequency analysis. Based on the obtained results, it can be concluded that there has been an improvement in students in the field of motor coordination. The results of the research indicated the importance of recognizing students with motor coordination difficulties as early as possible, as well as the importance of conducting educational and rehabilitation treatment, with a positive effect on motor coordination.

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Keywords: visual impairment, motor coordination, educational-rehabilitation program.

SAŽETAK

Motorički razvoj djeteta, posebno motorička koordinacija, važna je za izvođenje svrsihodnih aktivnosti. Cilj ovog istraživanja bio je utvrditi uticaj individualnog edukacijsko-rehabilitacijskog tretmana na motoričku koordinaciju kod učenika s oštećenjem vida. Uzorak ispitanika je obuhvatio jednog učenika, muškog spola, uzrasta 9 godina, s dijagnozom nistagmusa, ambliopije i astigmatizma. S učenikom je urađena inicijalna i finalna procjena, te je za istu korišten Beery-Buktenica razvojni test vizuelno-motoričke integracije (VMI) peto izdanje, koji je namijenjen za procjenu vizuelno-motoričke integracije, vizuelne percepcije i motoričke koordinacije. Za potrebe ovog istraživanja korišten je subtest *Motorička koordinacija* koji se sastoji od 30 zadataka. Nakon inicijalne procjene, proveden je individualni edukacijsko-rehabilitacijski tretman u trajanju od 2 mjeseca. Podaci istraživanja obrađeni su frekvencijskom analizom. Na osnovu dobijenih rezultata, može se zaključiti da je došlo do poboljšanja učenika u području motoričke koordinacije. Rezultati istraživanja ukazali su na važnost što ranijeg prepoznavanja učenika s teškoćama motoričke koordinacije, kao i važnost provođenja edukacijsko-rehabilitacijskog tretmana, uz pozitivan učinak na motoričku koordinaciju.

Ključne riječi: oštećenje vida, motorička koordinacija, edukacijsko-rehabilitacijski program.

INTRODUCTION

Visually impaired children differ according to personal characteristics, as well as according to the degree of visual impairment (Fajdetić, 2012). Because they face different developmental tasks and challenges posed by the environment (Farrel, 2004), visually impaired children need to be taught to interpret information gathered through visual sense, using a variety of motor skills. Therefore, it is important that they are well developed with the joint action of all other senses (Fajdetić, 2015). Beraković and Jokić Maršić (2018) state, that an important precondition for a child's optimal development in all developmental areas is the encouragement of motor development at an early age. Thus, the development of motor skills refers to the increasing ability of the child to harmoniously use its own body to move and use objects (Starc, Čudina-Obradović, Pleša, Profaca and Letica, 2004). Motor development takes place through children's movements at an early stage that represent reflex responses to the environment. Over time, these movements are upgraded and become increasingly cognitively controlled (Piaget, 1953; according to Carlson, Rowe and Curby, 2013), so motor skills are very important for the development of other traits. The development of the hand greatly affects the development of the whole organism. Performing various complex hand movements leads to the development of the cerebral cortex, which becomes the center for distinguishing a large number of stimuli that are received through hand movements.

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A significant part of the motor zone of the cerebral cortex is represented by the centers for hand and finger movements (Jablan, 2007; according to Radžo Alibegović and Teskeredžić, 2016). Motor skills are innate, but we can develop them in different ways from an early age, because the developed abilities serve to perform motor tasks more efficiently, and thus enable more successful movement (Pejčić and Trajkovski 2018). "The importance of motor skills can be reflected in the fact that if an individual does not develop certain abilities to a level that can be achieved, taking into account genetic limits, he/she will not be able to master everyday tasks necessary for normal functioning" (Bavčević, 2020). As such, motor skills are divided into different categories: gross motor skills refer to whole body movements (such as jumping), while fine motor skills include arm and hand movements. Fine motor skills are a prerequisite for the successful development of graphomotor skills, which implies the ability to perform graphemes (Ambrosi-Randić and Glivarec, 2017). Fine motor skills are very important for early learning (Becker, Miao, Duncan and McClelland, 2014), so fine motor skills developed in this way are shown in drawing, writing, cutting and painting and similar skills (Goldberg, 2003). The most important motor ability of a child is coordination. It is at the core of every movement (Iveković, 2013). It is also called motor intelligence, considering that it is a complex motor ability that participates in the realization of the simplest, but also the most complex forms of movement (Sekulić and Metikoš, 2007). **I**veković (2013) defines coordination as "the ability that enables the body to purposefully and in a controlled manner energetically, temporally and spatially organize two or more patterns of movement into one whole, in order to achieve specific movement." The frequency of visual disturbances or refractive anomalies in school children is 8% to 21%. In children of younger school age, initially, visual disturbances may manifest as fatigue at doing chores, headache, reluctance or refusal to read, write or do chores at school, burning in the eyes, watery eyes etc. Sometimes children with visual impairments help themselves without even being aware of it, when writing or reading, by bringing objects, papers, or a book closer to their eyes in order to see better (Teskeredžić, Mešić and Begić, 2018). Atasavun Uysal and Düger (2011) state, that children with various visual impairments lag behind in the development of motor skills, compared to children without visual impairment who improved their motor skills during primary school (Duvnjak, Soudil-Prokopec and Škrobo, 2015). In order to improve the motor development of these children, it is important to understand which motor skills, individually in each child, pose the biggest problems (Haibach, Wagner and Lieberman, 2014). In children with visual impairment, there is no reference point of movement, because of which the position of the body in space is somewhat different. Their movements are scarce and uncoordinated because they do not have the ability to imitate movements (in case they cannot be perceived by sight) as well as the supervision of movements (Duvnjak, Soudil-Prokopec and Škrobo, 2015).

The aim of the study was to determine the impact of individual educational and rehabilitation treatment on motor coordination in students with visual impairment.

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RESEARCH METHODS

Sample of respondents

The sample included one male student, aged 9, with a diagnosis of nystagmus, amblyopia and astigmatism. Visual impairment was binocularly corrected with spectacles (as of November 10, 2020), and the following correction was achieved:

OD: cum -1,50 Cyl ax 174°

OS: cum -1,00 Cyl ax 179°

The student is currently attending the 4th grade of the Elementary School "Turija" according to the regular educational program. He has never been involved in individual rehabilitation treatments to improve his visual and motor functioning. Regardless of the student's non-involvement in various programs, as well as untimely correction with glasses, his academic achievement is at the level of a very good student.

Measuring instrument

In order to verify the set goal of the research, the fifth edition of the Beery-Buktenica developmental test of visual-motor integration (VMI) (Beery K. E. and Beery N. A., 2004) was applied in the research. It can be used by children and adults, chronologically aged from 2 to 100, individually and in groups. The VMI test contains a total of 90 tasks and consists of : The main test "Visual-motor integration" and two additional sub-tests "Visual perception" and "Motor coordination". For the purposes of this research, the subtest "Motor coordination" was used, which consists of 30 tasks. The first three tasks are intended for preschool children. The child should sit on a chair on its own, take a pencil correctly, and solve tasks with one hand and hold the paper with the other hand. For the remaining 27 tasks, the child should draw the shapes with a pencil, but it must take care not to exceed the boundaries of the shapes. Children older than 5 years start with task number 4. Each correct answer is evaluated with 1 point, while incorrect answer with 0 points.

Research conducting method

The research was conducted individually, in the premises of the "Village of Peace" Foundation in accordance with the created activities within the program. First of all, an initial assessment was made in order to determine the current level of functioning of students in the field of motor coordination. Then the development of an individual educational-rehabilitation program was started, which consisted of exercises and a plan of necessary skills based on the improvement of gross and fine motor skills. The next step was to implement an educational-rehabilitation program, continuously for 7 weeks.

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When performing the activities, the working conditions were taken into account, such as: natural lighting in order to facilitate the student's activities; conducting the program in the morning, since then the student is most rested; provided peace and reduced the number of distractions within the room where the tasks are performed, so that the student maintains attention while working. For the rehabilitation program, the tasks from the Developmental Test of Visual Perception, Second Edition (DTVP-2) (Hammill, Pearson and Voress, 1993) were used, which relate to the following subtests: 1. Hand-eye coordination; 2. Position in space; 3. Mapping; 4. Separation of a figure from the background; 5. Relations in space; 6. Visual closure; 7. Visual-motor speed; 8. Constancy of shape. After the treatment, a final assessment was made to determine the effectiveness of the treatment on motor coordination in students with visual impairment.

Data processing methods

The statistical program SPSS 21.0 (Statistical Package for the Social Sciences) was used to process the obtained data. Survey data were processed by non-parametric statistics, basic statistical parameters, i.e. frequencies and percentages were calculated, and the obtained results were presented in tables and graphs.

RESULTS AND DISCUSSION

The role of the sense of vision in a child's development and the integration of information that we receive through other senses explains the negative effects of vision impairment on almost all developmental domains. If not corrected in time, visual impairment can have a negative impact on achievements in various areas of daily functioning (Stanimirov, Jablan, Andjelković and Vučinić, 2018; according to Begić Jahić, Vantić-Tanjić, Teskeredžić, Radžo Alibegović, 2019). Adequate visual perception and motor coordination are necessary for activities that require harmonious performance of motor skills. If visual and motor functioning is impaired, children will have various problems that will manifest themselves most often through mastering school tasks and chores, which will greatly affect the student's academic achievement, but also the student's self-confidence, if he/she often fails at school. Such children generally have untidy handwriting, as it is difficult to perform tasks that require developed fine motor skills, as well as skills needed for orientation and coordination of the body, and it is recommended to work with them using rehabilitation programs.

At the beginning of the treatment, the student showed certain deviations through the work when it comes to fine motor skills. The student was very inaccurate and slow, however, the readiness of the student to work and systematic exercises improved the quality of fine motor skills, which is evident through the results obtained by the later implementation of the educational-rehabilitation program. Through continuous treatments, the student shows more correct coordination of movements, more correct grip and holding of the pencil, as well as speed and accuracy during work.

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Table 1 shows the results in the field of motor coordination. The analysis of the obtained values determined the results that the student achieved on the tasks, in the final measurement after the educational-rehabilitation treatment. These results were best demonstrated in tasks 17, 18, 19, 20, 21, 22, 24 and 26, which relate to the tasks of spatial relations because they require that the template from the presented sheet be reproduced on the basis of evenly distributed dots. The only task in which the student showed the best results in the initial measurement, and failed to maintain it through treatment, was task number 16.

One of the reasons for the student's failure is the complexity of the task, since the task consisted of two figures connected at one point, which is difficult for the student to see due to the state of his visual function, i.e. the presence of nystagmus and astigmatism that does not allow spatial viewing and recognition of figures that are very close or meet only at one point.

Table 1. Presentation of results on motor coordination (initial-final)

Motor coordination	Assessment	Not done	Done
MC16	Initial		✓
	Intersection	✓	
	Final	✓	
MC17	Initial	✓	
	Intersection		✓
	Final		✓
MC18	Initial	✓	
	Intersection		✓
	Final		✓
MC19	Initial	✓	
	Intersection		✓
	Final		✓
MC20	Initial	✓	
	Intersection		✓
	Final		✓
MC21	Initial	✓	
	Intersection	✓	
	Final		✓
MC22	Initial	✓	
	Intersection	✓	
	Final		✓
MC24	Initial	✓	
	Intersection	✓	
	Final		✓
MC26	Initial	✓	
	Intersection	✓	
	Final		✓

Legend: MK- motor coordination.

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The tabular presentation (Table 2) shows the task results that have not changed, when it comes to the student achievement, in the field of motor coordination. In the initial testing, the student failed in the tasks presented below, and there was no positive progress, even after the individual educational and rehabilitation treatment.

Table 1. Presentation of results on motor coordination (no recorded changes)

Motor coordination	Assessment	Not done	Done
MC23	Initial	✓	
	Intersection	✓	
	Final	✓	
MC25	Initial	✓	
	Intersection	✓	
	Final	✓	
MC27	Initial	✓	
	Intersection	✓	
	Final	✓	
MC28	Initial	✓	
	Intersection	✓	
	Final	✓	
MC29	Initial	✓	
	Intersection	✓	
	Final	✓	
MC30	Initial	✓	
	Intersection	✓	
	Final	✓	

In the remaining variables of the instrument that are not tabulated (due to operationalization) student has successfully done through the initial testing, intersectional assessment, but also the final testing, done two months after the implementation of the individual educational-rehabilitation program.

Based on the results of the research, Graph 1 shows the summary results in the field of "Motor Coordination", obtained immediately before the implementation of the educational-rehabilitation program, one month after, and two months after the implementation of the educational-rehabilitation program. On the initial assessment, the student scored 16 points, and on the assessment done a month later, he scored 19, out of a total of 30 points. Compared to the initial assessment, the student scores 23 points in the final assessment, which confirms the importance of consistent application of individual educational and rehabilitation treatment with a student with motor coordination difficulties (Chart 1).

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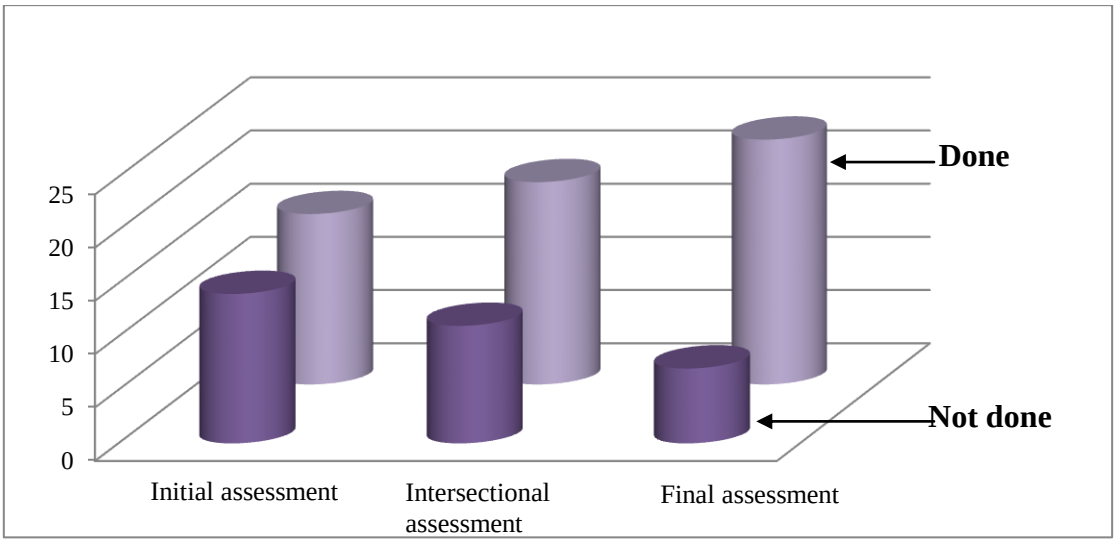

Graph 1. Summary result of frequencies on motor coordination

Sanghavi and Kelkar (2005) state that visual perception and motor functioning enable motor coordination and psychomotor speed necessary for adequate child functioning, while authors Wilson and McKenzie (1998) state that problems with visual components are related to problems in motor coordination.

Best (2010) considers that motor abilities that have the greatest connection with cognitive can be considered complex, because their performance requires a higher level of cognitive abilities, while those that are low correlation are such that require less cognitive engagement in task performance.

The results of research conducted by Lazarević, Stevanović and Lalić-Vuletić (2016) showed that more attention needs to be paid to developing fine graphomotor skills at preschool age, since the quality of graphomotor skills can significantly affect children's school achievement.

By reviewing various researches, it was realized that difficulties of visual perception have a negative impact on the development of motor skills, and that as such they negatively affect students' graphomotor abilities.

Difficulties in motor planning create difficulties in performing fine motor skills, which is further reflected in difficulties in writing (untidy handwriting), copying, slowness, difficulty navigating on paper, and clumsiness in tasks that require fine movements (Kuhar et al., 2007).

In order to improve the dexterity of the hands of these students, coordination of movements, and thus their academic achievement, it is necessary to continuously practice through rehabilitation programs that will certainly have positive effects on students' graphomotor skills.

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Coordinated hand dynamics in visually impaired children was examined by Radžo Alibegović and Teskeredžić (2016).

The sample consisted of 58 children, of which 29 children were visually impaired, and 29 children were without visual impairment. Coordinated hand dynamics was assessed using the psychomotor dimension B from the Ozeretski test. The results of the research showed that there is a statistically significant difference between visually impaired children and children without visual impairment on the psychomotor dimension B. For this reason, the authors recommend that in working with visually impaired children, it is necessary to pay special attention to exercises of visual-motor coordination (eye-hand) as well as exercises for the development of fine motor skills. The fact is that the coordination of hand movements depends on the interaction between the child, the task and the environment, and is the result of perception, environment and activity of the motor system (Tükel, 2013; according to Begić, 2020).

Press, Hinojosa and Roston (2009) conclude that intervention and subsequent improvement of graphomotor skills can have a positive effect on the overall academic achievement of students who have difficulties with motor development. In support of these results are the results of research by Ratzon, Ephraim and Bart (2007) who researched the impact of the intervention program on visual-motor skills and graphomotor skills. 52 students of elementary school age were selected by the method of random selection and they were classified in the experimental and control group. The experimental group participated in 12 treatments, which included motor and perceptual-motor activities, as well as activities for fine and gross motor skills. The results showed that students from the experimental group, after the concluded program, achieved significantly better results than students from the control group, which indicates the importance of implementing intervention programs in working with elementary school students.

The effect of the intervention program of fine motor skills on graphomotor skills was also examined by Spanaki, Venetsanou, Evaggelinou and Skordilis (2014) on a sample of 64 students involved in kindergarten and elementary school (33 boys, 31 girls). Graphomotor abilities were tested using visual-motor control items, Bruininks-Oseretsky motor ability-long form test (BOTMP-LF). The intervention program lasted two months. Analysis of the results showed significant interaction effects for each graphomotor skill. The authors concluded that elementary school teachers and kindergarten teachers should consider fine motor skills programs to improve the graphomotor skills of all students.

Smits-Engelsman, Niemeijer, and Van Galen (2001) in their paper explained that students with poorer graphomotor abilities find it more difficult to adapt to spatial orientation on paper. Such students, while performing the task on paper, use strategies that do not depend so much on their visual functions.

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The quality of the manuscript can have a positive effect on the treatment, which was confirmed by the results of the research, according to which it was concluded that children included in physiotherapy treatment showed greater precision in writing after 3 months of work.

CONCLUSION

In the early period of development of a visually impaired child, it is very important to encourage motor development, since the gross and fine motor skills are necessary for performing daily activities. In these activities, we also include performing school tasks, which is quite difficult for a student if he/she has impaired motor coordination. Difficulties in motor functioning, during schooling, will first be reflected through graph motor skills and problems with the coordination of fine and gross motor skills, which will further negatively affect the academic achievement of students.

Based on the results obtained in this research, it can be concluded that the academic achievement of visually impaired students can be improved if rehabilitation programs are conducted with him/her, and if the teaching content, teaching aids and environment are adapted to his/her abilities. Through constant work with the student, through the implementation of educational and rehabilitation treatment, more efficient manipulation of subjects was achieved, and there was an improvement in publishing school activities that require fine and gross motor skills. The progress of the students itself pointed to the need to conduct individual educational and rehabilitation treatment with students with motor coordination difficulties, for a longer period of time, in order to achieve the set goals. Before implementing the educational-rehabilitation program, it is necessary to determine the current level of functioning of students, and in accordance with that, to create and implement a program.

The analysis of the obtained values, in this research, established that the individual-educational rehabilitation program showed a positive shift in the field of motor coordination, and that this achievement was best reflected in graphomotor skills, gross motor skills and body coordination.

By early detection of students with impaired motor coordination, it would be possible to act in a timely manner and start creating different therapeutic approaches. It is also important to encourage further research in the future on the importance of the need to implement rehabilitation programs in working with these students.

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