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THE RELATIONSHIP BETWEEN VISUAL-MOTOR INTEGRATION AND SCHOOL SUCCESS FOR DEAF AND HARD OF HEARING STUDENTS IN ELEMENTARY SCHOOL

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SUMMARY

Visual-motor integration can be seen as ability to understand visual information, with purpose for that information to be used for tasks like drawing, writing, sports, using tools and accessories and other school activities. Connection between school success and visual-motor ability to integrate is set as our research goal.

The study sample consisted 30 deaf and hard to hear children, age between 8 and 16 years. We used Beery-Buktenica test of visual-motor integration, and the results are shown in raw scores. Students from 5th to 8th grade had higher score, 17,25 unlike younger students, whose average was 13,90, and the difference is not statistically significant (t=1,454; p=0,157). Students with medium hard hearing loss scored the most points at the test AS=20,75, less points were achieved by students with total deafness AS=20,00, next students with mild hearing loss AS=16,00 and students with severe hearing loss AS=13,80. ANOVA testing showed no statistically important differences in achievements based according to the hearing loss (F=1,769; p=0,167). The difference between students with cochlear implant (AS=19,44) and the students who wear hearing aid (AS=14,71) is statistically important (t=2,066; p=0,048). The results of ANOVA test showed that there is no connection between success on visual-motor integration and success in the area of mathematics (F=1,952; p=0,163) and native language (F=1,952; p=0,163), as for art and P.E. we have found (t=2,858; p=0,008); (t=2,197; p=0,037). Early identification of difficulties in visual-motor integration is important, because it leads to early treatment, which can significantly contribute to higher achievements in school.

Key words: deaf and hard of hearing students, visual-motor integration, school success

INTRODUCTION

Visual-motor integration is defined as integration of visual perception and motor presentation of perceived. We determine visual-motor functions on child as coordination of movement and perception, which allows child to create in space and to express in graphomotoric way. Difficulties in conducting visual-motor functions directly impact hand coordination which is under the visual control. Problems which best show difficulties in visual-motor functions are bad and messy handwriting, difficulties in space organization of writing, which affects success in school (Krstić, Dukić & Kovačević, 2010).

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Difficulties in visual-motor integration potentially affect all areas in person's life: social, academic, sports, professional. Because of a person's lack of visual tracking ability, it is very difficult to organize movements and objects in space.

Some of the signs which point to visual-motor integration problems are:

1. Messy drawing and writing.
2. Excessive use of eraser.
3. Don't admit mistakes.
4. Bad organization.
5. Incapability of following a line with a pencil.
6. Bad posture during writing.
7. Incapability in solving tests, even though they know the topic.
8. Absence of answer in paper.
9. Difficulties in coordination of numbers in mathematical columns.

Visual-motor integration disorder can be found under these names:

1. Developing abstraction
2. Graphomotor discoordination
3. Visual-perceptual-motor dysfunction
4. Nonverbal LD syndrome

As some children who are deaf and hard of hearing grow in conditions where they lack one of the most important stimulants (such as sound) from environment, some aspects of psycho-motor activity can be lower in comparing with children with normal hearing (Radovanović, Radić-Šestić, Karić & Milanović-Dobrota, 2013). The results of the study show that deaf and hard of hearing children achieve lower results on visual-motor integration test compared to children of typical development (Lotz, Kroese, Puffer & Osberger, 1986). Contrary to this are results of other studies where results of the visual-motor integration are similar to results of their typically developed peers (Spencer & Delk, 1989; Dodd, Woodhouse & McIntosh, 1992).

One study examined perception, visual memorizing numbers and motor skills between deaf and persons with normal hearing. It was determined that deaf persons are behind in all abilities, except in perceiving the difference in weight (MacMillan & Bruner, 1906).

Visual-motor integration skills are important due to their contribution to the normal development of manual dexterity, coordination, speed, balance, and writing (Dawson & Watling, 2000a). It is very important variable for children's handwriting skills. There are various factors like visual-perceptual, motor planning, motor memory, sequencing etc, but Sovic found that visualmotor integration is an important variable to a child's handwriting skills (Sovik, 1975).

Problems which contribute VMI are noticed at children with disability, and it is highly shown during drawing of geometric shapes (Thomas & Hacker, 1987). Children with disability have visual-motor in performing precise activity, such as using scissors, drawing geometric shapes, copying of the design, claims Tranopol.

Karlsdottir and Stefansson (2003) found that the correlation between the results of the VMI and the quality of handwriting tend to decrease with age.Other studies have been carried out among samples of children with identified disorders. Within a group of children (10 year-olds) composed of clumsy children and of dysgraphic children,

Maeland (1992) investigated the relationship between the VMI and the quality of handwriting based on a dictation.

Volman, van Schendel, and Jongmans (2006) confirmed a significant relationship between visual-motor integration and the quality of handwriting with children who present developmental coordination disorder (American Psychiatric Association [APA], 1994).

Research purpose

The purpose of this research was to determine the connection between the ability of visual-motor integration and success in maternal language, mathematics, art and physical education with deaf and hard of hearing elementary school children. Besides, we were interested in influence of growth, level of hearing loss and the type of amplification on visual-motor integration abilities.

MATERIAL AND METHOD

Sample

The sample of this study consisted of 30 deaf and hard of hearing children, from 8 to 16, students of "School and dorm for deaf and hard of hearing children", and students of two elementary schools from Kragujevac. In relation to school age there were 10 (33%) students with lower school age and 20 students (67%) with higher school age ($\chi 2$= 3,333; p=0,068). Relative to the gender, there were 17 male students (57%) and 13 female students (43%) ($\chi 2$=0,533; p=0,465).

Variables of research

Independent variables are: age, level of hearing loss, type of amplification, success in maternal language, success in mathematics, success in art, success in physical education, while the dependent variable is the success of deaf and hard of hearing students on visual-motor integration test.

Research Techniques and Instruments

In the research, we used visual-motor integration test (*Beery VMI – Keith E. Berry, Norman A. Buktenica and Natasha A. Beery*), the longer form, intended for evaluating examinees from age 2 to 100 years. Test for visual-motor integration is consisted with 30 questions, arranged with lower to higher principle. It is required that a child draws certain object in specially framed empty space which is located under the required form.

The rules of the test are:

- It is required that a child sits properly
- Properly holds a pen
- Properly holds the paper with one hand, and with other one draws

Child received 1 point: if it completely and accurately draws the required shape, if draws the required shape half, for doing the task with help of examiner (examiner draws on his paper the same shape, and the child draws it looking at the examiners paper and drawing the shape on his own space), and if a child draws the required shape in a way that the lines don't cross over the frame.

Maximum number of points is 30.

Test ends if a child repeatedly draws 3 shapes wrongly.

Kronbach alpha coefficient for this research is 0,813.

Experimental procedure

The information on age, level of hearing loss, type of amplification, academic achievement in maternal language, mathematics, art and physical education were acquired from the school's administration. The test was applied individually in a classroom. We strive to ensure that every child has a sign language translation. If he or she needs it. The roles of visual-motor integration test asks requires from children to solve the tasks independently, and the examiner gives additional explanations, if it is necessary.

Data processing methods

Data received from the research has been processed with adequate statistical methods and actions. The measures of descriptive statistics, which we've used, are: percentages, arithmetical environment, standard deviations and the measures of calculating significance of difference between average value achieved in test; t-test and ANOVA test.

Processing data will be carried out on PC computer with using program: SPSSS 20 for statistical data analyze, EXCEL 2007 for data base and charts, WORD 2007 for text processing.

RESULTS OF THE RESEARCH

Students results relative to maternal language success

In Table 1 are shown the results which deaf and semi-deaf students have made at visual-motor integration test regarding to their mother tongue success.

Table 1 *Students' success in visual-motor integration test regarding to mother tongue success*

Visual-motor integration/ mother tongue/success	N	AS	SD	df	F	P
Excellent	8	19,88	4,39			
Very good	13	16,08	6,10	2	1,952	,163
Good	7	14,43	5,74			

The excellent grade students have been the most successful in visual-motor integration test, with 19,88 points made, next are the very good grade students, with 16,08 points, while the good grade students have made only 14,43 points.

Testing the ANOVA test, there has not been found any statistically significant differences when observing the mother tongue grade (F=1,952; df=2; p=0,163). Foreign research results show connection between visual-motor integration and quality of handwriting (Comhill & Case-Smith, 1996; Tseng & Murray, 1994; Weintraub & Graham, 2000). Quality of handwriting is just a segment which is used for completing the grade in mother tongue, and mostly at younger age, assumption is, that because of that reason there have not been found any differences at students' achievements in test.

Students results relative to mathematics success

Table 2 *Students' success in visual-motor integration test regarding to mathematics success*

Visual-motor integration/ mathematics success	N	AS	SD	df	F	P
Excellent	5	16,60	3,21	3	2,413	,092
Very good	8	20,88	3,60			
Good	12	14,83	6,44			
Sufficient	3	13,67	7,23			

Table 2 shows the results which deaf and semi-deaf students have made at visual-motor integration test regarding to mathematics success.

The highest success in visual-motor integration test, with 20,88 points, have made the very good grade students, next are the excellent grade students and 16,60 points, and finally the good grade students with 14,83 points. The worst result have made the sufficient grade students, only 13,67 points. With testing the ANOVA test, there has been statistically significant difference in students success (F=2,413; df=3; p=0,092).

Beery (1982) determined a high connection between visual-motor integration and success in mathematics, which confirms the other authors' findings (Kulp, 1999; Mazzola et al, 2003).

Students results relative to art success

Table 3 *Students' success in visual-motor integration test in regard to art success*

Visual-motor integration/art success	N	AS	SD	t	df	P
Excellent	23	18,04	5,51	2,858	26	,008
Very good	5	10,80	2,05			

Table 3 shows the results which deaf and hard of hearing students have made at visual-motor integration test in regard to art success.

The most successful in visual-motor integration test have been the excellent grade students, who have made 18,04 points, while the lowest success level have had the very good grade students with 10,80 points. T test determined that there have been statistically significant differences in achievement success in visual-motor integration test in favor of the excellent grade students (t=2,858; df=26; p=0,008).

Students results relative to physical education success

Table 4 *Students' success in visual-motor integration test in regard to physical education success*

Visual-motor integration/ physical education success	N	AS	SD	t	df	p
Excellent	24	17,67	5,70	2,197	26	,037
Very good	4	11,25	2,06			

Table 4 shows the results which deaf and hard of hearing students have made at visual-motor integration test in regard to physical education success.

The excellent grade students have made, on average, 17,67 points and they have been more successful than the very good grade students, who made 11,25 points. T test determined that there have been statistically significant differences in achievement on visual-motor integration test in favor of the students with grade excellent (t=2,197; df=26; p=0,037). Volman, van Schendel, and Jongmans (2006) have determined significant connection between BMI and handwriting quality with children who have developing disorder of coordination and physical education.

McHale & Cermak (1992), Sanghavi & Kelkar (2005) claim that if students don't have well developed visual-motor integration, it can affect their achievements in school and teachers can't be sure what they have learned and mastered. Results of our research are accordant to these findings, because better results at VMI test have made the students with higher grade in art and physical education.

The influence of age, level of hearing loss and type of amplification are shown in the following tables 5, 6, 7, 8 and 9.

Table 5 *Students' success in visual-motor integration test regarding to their age*

Visual-motor integration/age	N	AS	SD	t	df	p
From 1 to 4	10	13,90	5,51	1,454	28	,157
From 5 to 8	20	17,25	6,15			

Table 6 *Students' success in visual-motor integration test in regard to their gender*

Visual-motor integration/Gender	N	AS	SD	t	df	p
Boys	10	15,53	6,18	,617	28	,542
Girls	20	16,92	6,06			

Table 7 *Students' success in visual-motor integration test in regard to their level of hearing loss*

Visual – motor integration/ Level of hearing lost	N	AS	SD	df	F	p
Mild	2	16,00	,000	4	1,769	,167
Moderate	5	13,80	8,468			
Moderately difficult	4	20,75	1,893			
Difficult	14	14,29	5,810			
Profound	5	20,00	4,848			

Table 8 *Students' success in visual-motor integration test in regard to their type of amplification*

Visual-motor integration/type of amplification	N	AS	SD	t	df	p
Hearing aid	21	14,71	6,18	2,066	28	,048
Cochlear implant	9	19,44	4,47			

Table 9 *Students' success in visual-motor integration test in regard to their model of communication*

Visual-motor integration/model of communication	N	AS	SD	df	F	p
Signed language	11	15,36	5,732	2	,502	,611
Spoken language	11	15,55	5,989			
Total model	8	18,00	6,969			

Based on results at T test, it has been determined that there are no statistically significant important differences in achievement in visual-motor integration test between younger and older students (t=1,454; p=0,157). According to the research (Radovanovic et al., 2013) there have not been found any significant difference between boys and girls ' achievements at visual-motor integration test (t=,617; p=0,542). Also, comparing to level of hearing loss, there has not been significant difference in students achievements (F=0,916; p=0,470). We have not found any statistically significant differences when observing the model of communication (F=0,916; p=0,470). Hauser, Cohen, Dye, Bavelier, (2006) have claimed to find high correlation of writing and reading skills with deaf and hard of hearing students, also with academic achievements on copying of figures test, while at our research, the students, who use sign language, have had the lowest success level.

The only statistically significant difference has been determined between the results which students made regarding to the model of amplification, in favor of students with cochlear implant (t=2,066; p=0,048), which is according to the results which were collected by Horn, Davis, Pisoni & Miyamoto (2004).

CONCLUSION

The goal of our research is to examine the connection between success in school and achievement at visual-motor integration test with deaf and hard of hearing children who are in elementary school.

We examined visual-motor integration by re-drawing the simple and complex shapes. We examined the influence of independent variables (age, gender, hearing damage level, success at maternal language, mathematics, art and physical education, type of amplification, model of communication) on dependent variables.

Based on our research, we have concluded that success in art and physical education has significant role in solving this test, while success in mother tongue and mathematics has not been shown as statistically important.

While researching the age, gender and model of communication on visual-motor integration test, we have not found any statistically significant results. However, when examining the amplification in relation to visual-motor integration test, we have found significant statistical data.

The results of our research could open the space for new researches in visual-motor integration area of deaf and hard of hearing students. It would be particularly interesting to compare visual-motor integration abilities and success in school with deaf and hard of hearing students and the ones with typical development.

Visual-motor integration is the ability in which can be affected, so the results could contribute to working with deaf and hard of hearing children. There are certain activities that can be done before every class: certain exercises of attention, movements coordination, students can draw their fingers on the edge of the school bench, cut paper with scissors... In certain lessons they should practice writing, re-writing of shorter texts, which would be expanded in time and becoming more and more complicated, and also drawing and re-drawing simple shapes to more and more complicated ones, in notebook and sketchbook, as well as on blackboard. At physical education lessons, students can practice more some exercises for movement coordination, and at the end of other lessons, they can occasionally practice improvement of the motor ability.

The connection of visual-motor integration readiness between writing and academic success is a field which is not sufficiently examined in our environment. Considering that the level of physical activity with children depends on individual influences, influence of school facilities, parents and environment, and considering that students learn more through indirect experience in contact with environment and other people, educational process can't be practiced and used only inside schools walls, or limited with tasks and contents which are predicted by a program. Actually, it should be constantly used in everyday life, not separating work from play, acting from thinking and knowledge from its everyday use in every days situations. The most important thing is, that if we notice a problem, we act instantly in order to improve reduced functions.

It is extremely important that parents notice and pay attention to irregularities in psycho-motor development at child, and that can be achieved with training and counseling parents, so that they recognize stagnation in psycho-motor development, who should they contact and what is the best way for them to help their child.

REFERENCES

1. American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders, 4th ed.* (DSM-IV). Washington, DC: Author.
2. Beery, K.E. (1982). *Revised administration, scoring and teaching manual for the Developmental Test of Visual-Motor Integration,* Cleveland: Modern Curriculum Press.
3. Cornhill, H., & Case-Smith, J. (1996). Factors that relate good and poor handwriting. *The American Journal of Occupational Therapy*, 50(9), 732–739
4. David, L. Horn, R., Davis, A.O., David, B. Pisoni, R., Miyamoto, T. (2004). Visuomotor integration ability of pre-lingually deaf children predicts audiological outcome with a cochlear implant: a first report. *International Congress Series* 1273:356-359, United States.
5. Dawson, G., & Watling, R. (2000a). Interventions to Facilitate Auditory, Visual, and Motor Integration in Autism: A Review of the Evidence. *Journal of Autism and Developmental Disorders*, 30(5), 415-421.
6. Dodd, B., Woodhouse, L., & McIntosh, B. (1992). The linguistic abilities of young children with hearing impairment: First report of a longitudinal study. *Australia and New Zealand Journal of Developmental Disabilities*, 18, 17–34.
7. Hauser, P. C., Cohen, J., Dye, M. W. G., Bavelier, D. (2006). Visual Constructive and Visual–Motor Skills in Deaf Native Signers. *Journal of Deaf Studies and Deaf Education*.
8. Крстић, Т., Дукић, О., Ковачевић, А. (2010). Полне разлике у зрелости визуомоторних функција на раном предшколском узрасту. *Педагогија*, вол. 65, бр. 4, стр. 636-644.
9. Kulp, M. T. (1999). Relationship between Visual Motor Integration Skill and Academic Performance in Kindergarten through Third Grade. *Optometry & Vision Science, 76*(3), 159-163.
10. Lotz, W., Kroese, J., Puffer, C., Osberger, MJ., (1986). Visual Processing Short-Term Memory, and Visual Motor Coordination Skills. *ASHA Monographs*, 23, pg. 77-83.
11. MacMillan, D.P, & Bruner, D. G. (1906). *Child study and pedagogic investigation on children attending the public day schools for the deaf in Chicago.* Chicago: Chicago Board of Education.
12. Maeland, A. F. W. (1992). Handwriting and perceptual-motor skills in clumsy, dysgraphic, and normal children. *Perceptual and Motor Skills*, 75, 1207–1217.
13. Mazzola, S. J., Kulp, M. S., & Taylor, M. (2003). Are the Results of the Beery-Buktenica Developmental Test of Visual-Motor Integration and Its Subtests Related to Achievement Test Scores?. *Optometry and vision science, 80*(11), 758-763.
14. McHale, K., & Cermak, S. A. (1992). Fine motor activities in elementary school: Preliminary findings and provisional implications for children with fine motor problems. *American Journal of Occupational Therapy, 46*(10), 898-903.
15. Radovanović, V., Radić-Šestić, M., Karić, J., Milanović-Dobrota, B. (2013). The Influence of Computer Games on Visual-Motor Integration in Profoundly Deaf Children. *British Journal of Special Education*, Article ID: BJSP 12042
16. Sanghavi, R., & Kelkar, R. (2005). Visual-motor integration and learning disabled children. *Journal of Indian Occupational Therapy*, 27(2), 33-38.
17. Sovik, N. (1975). *Developmental cybernetics of handwriting and graphic behaviour*. Boston: Universitetsforlaget.
18. Spencer, P., & Delk, L. (1989). Hearing-impaired students' performance on tests of visual processing: Relationships with reading performance. *American Annals of the Deaf*, 134, 333–337.
19. Thomas, L.K., Hacker, B.J. (1987). *A Therapist's guide to pediatric assessment*. First edition, Boston: Little Brown & Company, 146-148.

20. Tseng, M., & Murray, E. (1994). Differences in perceptual motor measures in children with good and poor handwriting. *Occupational Therapy Journal of Research*, 14, 19-36.
21. Volman, M. J. M., van Schendel, B. M., & Jongmans, M. (2006). Handwriting difficulties in primary school children: a search for underlying mechanisms. *American Journal of Occupational Therapy*, 60, 451–460.
22. Weintraub, N., & Graham, S. (2000). The contribution of gender, orthographic, finger function, and visual-motor process to the prediction of handwriting status. *Occupational Therapy Journal of Research,* 20, 121-140.