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DETERMINANTS OF ELEMENTARY STUDENT'S WRITING TOOL MANIPULATION SKILLS

Abstract: Writing, as a skill of correct graphic design, represents an activity which is very important in each individual's life and work, and the period of elementary school, when writing skills are mastered, is the period when special attention must be devoted to determinants that can affect the process of writing. Gender, literacy phase and writing difficulties are the determinants that have been tested in 1156 elementary school students, and the research was done in the eight Belgrade elementary schools in 2016. Statistically significant differences in the writing tools and materials manipulation skills among students with and without writing difficulties were present. The students without writing difficulties had higher manipulation skills, and the biggest difference was recorded in the effective stabilization of paper with the non-dominant hand ($r = .000$), placing paper under an adequate angle ($r = .000$) and presenting comments and complaints of pain or fatigue ($r = .000$). The strongest statistically significant difference with the presence of difficulties in the writing tools and materials manipulation skills between boys and girls is recorded in the effective stabilization of paper with the non-dominant hand ($r = .000$). Students who are in the process of acquiring literacy skills have the greatest difficulties in the presence of pain or fatigue during writing (23.2% of students). The strongest statistically significant difference in the manipulating skills between students of the first and second grades, compared to the students who have already mastered writing, is in setting up paper at an adequate angle ($r = .000$) and in the presence of pain or fatigue ($r = .000$). Gender, the stage of literacy and writing difficulties are determinants that affect the skill of manipulating writing tools. Thus, studying this problem is very important in order to help students master the skills of writing. Individualization measures, as one of the modes of adapting teaching to the abilities of students, can make this complex process significantly easier for them.

Key words: age, gender, individualization, writing, writing difficulties.

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Introduction

During the elementary school period, curricula are designed so that the implementation and acquisition of almost all the teaching material requires writing skills. This has been confirmed by previous research, which shows that this skill is allotted the largest amount of time, as much as 30% to 60% of the time spent in educational work is directed to it (Volman, et al., 2006).

Writing, as "the ability to copy letters and numbers in a determined time and form" (Ashiani, et al., 2014: 1681), is "a skill of proper graphic design of letters" and a complex psychomotor process coordinated by a complex nervous system (Defektoloski leksikon, 1999: 280). Golubovic and Golubovic (2001: 139) define that writing as "a complex psychophysiological skill which is based on the performance of fine coordinated movements that form a motor act and which belong to the group of willing activities"; namely writing represents the most complex human ability (Golubovic, 2003), as well as a complex skill that requires coordinated engagement of the motor and gnostic system.

Although research shows that most attention at school is devoted to this skill, today many students have writing difficulties, even up to 25% of students (Marr & Dimeo, 2006). The difficulties are reflected in inadequate writing speed, inadequate readability of the written text, or, very often in a combination of the difficulty in the speed and legibility of writing. Consequently, the interest of researchers to deal with this problem is growing and with it there is an increase in the number of studies dealing with the determinants of writing skills, as well as the determinants of the skills of using and manipulating the writing tools and materials.

Determinants of writing skills

The use of a pen, first through scribbling and drawing, is the skill that children master at the earliest age. With time, the hand is gradually being prepared for the writing act and the start of elementary school. School activities are focused on adopting and practising writing skills. Before starting school, children are in a scribble phase during which vertical, horizontal and circular lines appear, and which will later represent the elements of letters. After this phase, the drawing phase ensues, during which various symbols and forms can be identified in the child's drawing (Puranik & Lonigan, 2011). According to Golubovic (1998), the initial period of writing skill acquisition is characterized by separate writing of each individual element, long pauses and slow writing, many excessive movements, unevenness of graphic forms and muscular effort. After this period, ensues a period which involves intensive learning of writing during the first and second grade, while perfecting writing skills represents the final phase, i.e. the phase of the individualization of handwriting, when students are enabled to write at the appropriate speed and quality, and this period occurs in the third grade (Bojanin, 1985).

At the beginning of the literacy period, writing demands constant engagement of the perceptual system, both visual and kinesthetic, as well as tactile, along with constant thinking about the process of writing letters, position and movements of the hand, i.e. it is not yet an automated action. Later, in the period between eighth and ninth years, writing becomes an automated action, hence it is necessary to detect any difficulties encountered by students as early as possible (Overvelde & Hulstijn, 2011). As a complex psychomotoric process, writing and writing difficulties are often associated with the gender of the child (Medwell & Wray, 2007; Schweltnus et al., 2012a), with the assertion that writing problems are more often

present in boys, but also tightly connected to the age of the child and the time spent practicing writing (Schwellnus et al., 2012a; van Hartingsveldt, et al., 2015).

Students with writing problems are students who encounter difficulties in mastering writing skills during their schooling. With some students, these difficulties concern the speed of writing, with some students they are reflected on the look and readability of the written text, while for one group of students they cover both aspects. Based on numerous studies (Bosga-Stork et al, 2016; Golubovic & Colic, 2011; Petakov Vucelja, 2011; Santos Damasceno, et al., 2015; Schwellnus et al., 2012a; Schwellnus et al., 2012b), writing problems, observed through the speed of writing and the legibility of the written text, are present in a large number of elementary school students, with very frequent difficulties in manipulating writing tools and materials. Apart from inappropriate pencil manipulation, the problem of placing paper under an adequate angle and its stabilization, many students are confronted with pain and fatigue during writing. Pain and fatigue can very often result in slower or less readable writing (Summers & Catarro, 2003), and inappropriate holding of the pen is a very common cause to these problems. These problems are more apparent with students who are only starting to master the writing skills, since the locomotor apparatus has not been fully adjusted to perform tasks that require writing for a longer period of time.

Because an insufficient amount of attention is paid to this problem, the students are most often characterized as lazy and uninterested, it is necessary to study and define the determinants of the skill of manipulation with writing tools and materials during writing, in order to help students overcome existing difficulties. Therefore, the subject of the research are the factors that influence the skill of manipulating the writing tools, in order to determine whether gender, literacy phase, and the existence of difficulty in writing are determinants.

Based on the subject of research and its defined goal, it is assumed that girls are more skilful in manipulating writing tools and materials during writing; that students who have mastered writing skills are more skilled in manipulating writing tools and materials while writing, compared to learners who are at the beginning of literacy, and that students with writing difficulties have more difficulty in manipulating writing tools and materials when writing as compared to students who do not have any difficulties.

Methodological framework of the research

Research Sample. The survey was conducted in 2016, and 1156 students of the lower grades (I-IV) of the eight elementary schools in Belgrade, 564 male respondents (48.8%) and 592 female respondents (51.2%) participated in the research. In defining the category of students with writing difficulties, two criteria were used: the first was inadequate writing speed (defined based on the norms of the The McMaster Handwriting Assessment Protocol, for different classes), and the second, the presence of more than three indicators of qualitative changes in writing. Based on these two criteria, it has been found that 118 students (10.2%) from the sample of children can be classified into a group of students with writing difficulties. Due to the large disproportion in the number of students who entered in the categories of respondents with and without difficulties, a control sample was formed using the pairing method and this procedure led to the formation of two sub-samples within the main sample, both with 116 respondents. In each sample, there were 76 (65.5%) boys and 40 (34.5%) girls; 33 (28.4%) students of the first, 32 (27.6%) students of the second, 22 (19%) students of the third and 29 (25%) students of the fourth grade.

In defining the category of students who were in the phase of mastering writing skills and students who had already mastered writing the curriculum was used. This curriculum serves as a guideline for practicing letters and practicing writing skills. The curriculum for the education of the first and second grade of elementary education (ZUOV, 2017a) prescribes that students during this period in Serbian language classes, through defined goals and tasks, work on mastering the writing technique in the Cyrillic script during the first grade and in the second grade master the technique of writing the Latin script, while the third and fourth grade period prescribes improving writing (ZUOV, 2017b; ZUOV, 2017c). Thus, the students were divided into two groups, the first group consisted of 603 pupils (52.2%) of the first and second grades, and the second group of 553 pupils (47.8%) of the third and fourth grades.

Assessment instrument. The McMaster Handwriting Assessment Protocol - 2nd edition (Pollock et al., 2009) was used as a measuring instrument for the assessment of writing, which, with the author's approval, was translated and adapted to the Serbian language (Denic & Milivojevic, 2014). In addition to assessing how the pen is held and speed, and readability of writing, the protocol includes the assessment of the manipulation of writing tools and materials. During the implementation of writing tasks that included writing by heart, writing according to dictation, and copying texts from a smaller and larger distance, it was observed if during the students writing the following determinants were present: effective paper stabilization with the non-dominant hand, controlled use of the writing tool, keeping the pen at an adequate angle in relation to paper, placing paper at an appropriate angle (30-35°), and the presence of pain and/or fatigue during writing.

Statistical data processing. In the statistical data processing, descriptive statistics were used, and Pearson's correlation coefficient was used to test the relationship between variables. Statistical processing and analysis was done in the computer program SPSS, 20 (Statistical Package for the Social Sciences).

Research results

Five elements were observed in the analysis of the use of the writing tools and materials. Together with the frequency of their occurrence in the whole sample, they are shown in Table 1.

Table 1. Frequency of use of writing tools and materials

Writing tools and materials	N	%
Effective paper stabilization with the non-dominant hand	1095	94.7
Controlled use of writing tools	1140	98.6
Keeping the pen at an adequate angle in relation to paper	1130	97.8
An adequate angle of paper	978	84.6
No comments or complaints about pain or fatigue	936	81.0

As Table 1 shows a high percentage of the respondents appropriately used writing tools and materials, the majority of the participants used writing materials and held writing tool at an adequate angle in a controlled manner; almost 95% performed paper stabilization with the non-dominant hand while writing, while over 80% of the sample exhibited the adequate position of the paper and the absence of complaint about fatigue or pain while writing. Based

on the results presented, it was noted that as much as 19% of students complained about pain or fatigue, and that 15.4% of students did not keep paper at an adequate angle while writing. Table 2 presents the use of writing tools and materials of students with and without writing difficulties, seen on sub-samples composed of 116 students with writing difficulties and 116 students with no writing difficulties.

Table 2. Use of tools and materials of students with and without difficulty in writing

Tools and materials		N	%	Writing Difficulties - categories				X ²	p
				Without writing difficulty		With writing difficulty			
				n	%	n	%		
Effective paper stabilization with the non-dominant hand	Yes	239	91.1	115	99.1	94	81	21.284	.000
	No	23	9.9	1	0.9	22	19		
Controlled use of writing tools	Yes	223	96.1	116	100	107	92.2	9.363	.002
	No	9	3.9	0	0	9	7.8		
Keeping the pen at an adequate angle in relation to paper	Yes	218	94	115	99.1	103	88.8	10.946	.001
	No	14	6	1	0.9	13	11.2		
An adequate angle of paper	Yes	166	71.6	104	89.7	62	53.4	37.354	.000
	No	66	28.4	12	10.3	54	46.6		
No comments or complaints about pain or fatigue	Yes	171	73.7	98	84.5	73	62.9	13.901	.000
	No	61	26.3	18	15.5	43	37.1		

Observing both sub-samples, or as a whole a group of students with and without difficulties in writing (Table 2), it was noted that the greatest difficulty in manipulating tools and materials was positioning the paper at an adequate angle (28.4% of pupils), as well as the presence of pain or fatigue while writing (26.3% of students). The least difficulties were exhibited in the adequate use of writing tools (3.9% of students). If we observe the group of students with writing difficulties, it can be noticed that they also had the greatest difficulty in placing paper at an adequate angle (46.6% of pupils), as well as in the presence of pain or fatigue while writing (37.1%), as was the case with students who did not have these difficulties. The difference in the presence of difficulties in the manipulation of tools and materials between students with and students without writing difficulties was recorded in all the tested parameters. The highest statistically significant difference was recorded in the effective stabilization of paper with the non-dominant hand ($p = .000$), placement of paper under an adequate angle ($r = .000$) and the presence of comments and complaints about pain or fatigue ($p = .000$). However, it was also present in the controlled use of writing tools ($p = .002$) and setting the writing tools at an appropriate angle in relation to paper ($p = .001$). Even though it can be noticed that both groups of students had the most difficulties in setting the angle of the paper during writing, and frequent presence of pain and fatigue, a statistically significant difference between these two parameters was noted and this number was significantly larger with students who encountered writing difficulties.

Apart from showing that the presence of learning difficulties is a determinant that significantly influences the manipulation of tools and materials during writing, gender is considered to be one of the determinants as well. Therefore, Table 3 shows the usage of writing tools by boys and girls of lower grades of elementary school.

Table 3. Use of tools and material of boys and girls

Tools and materials		Gender				X ²	p
		Boys		Girls			
		n	%	n	%		
Effective paper stabilization with the non-dominant hand	Yes	521	92.4	574	97	12.140	.000
	No	43	7.6	18	3		
Controlled use of writing tools	Yes	551	97.7	589	99.5	6.842	.008
	No	13	2.3	3	0.5		
Keeping the pen at an adequate angle in relation to paper	Yes	546	96.8	584	98.6	4.448	.027
	No	18	3.2	8	1.4		
An adequate angle of paper	Yes	461	81.7	517	87.3	6.937	.005
	No	103	18.3	75	12.7		
No comments or complaints about pain or fatigue	Yes	441	78.2	495	83.6	5.513	.011
	No	123	21.8	97	16.4		

Observing the group of boys (Table 3), it can be noticed that the greatest difficulties were in positioning the paper at an adequate angle (18.3% of pupils), as well as in the presence of pain or fatigue during writing (21.8% of pupils), which was the case with girls where the presence of pain or fatigue was recorded in the largest percentage (16.4% of pupils), then problems with placing paper at an adequate angle (12.7%). The difference in the presence of difficulties in the manipulation of tools and materials between boys and girls was recorded in all the tested parameters, and the highest statistically significant difference was recorded in the effective stabilization of paper with the non-dominant hand ($p = .000$) and it was highly statistically significant. The next difference was seen in the presence of difficulty in placing paper under an adequate angle ($p = .005$) as well as the presence of comments and complaints about pain or fatigue ($p = .011$). It was also present in the controlled use of writing tools ($p = .008$) and in setting the writing tool at an appropriate angle in relation to paper ($p = .027$) for the benefit of girls who were more successful in manipulating the writing tools and materials during writing. Apart from the results showing that gender is a determinant which significantly influences the manipulation of tools and materials while writing, it is considered that the age or phase of literacy, is one of the determinants as well. Therefore, Table 4 shows the manipulation of writing tools by students who are in the phase of mastering writing skills (pupils of the first and second grade) and students who have already mastered the writing skills (students of third and fourth grade).

Table 4. Use of tools and materials in relation to the literacy phase

Tools and materials		Phase of literacy				X ²	p
		Initial (I and II grade)		Final (III and IV grade)			
		n	%	n	%		
Effective paper stabilization with the non-dominant hand	Yes	571	94.7	524	94.8	.002	.534
	No	32	5.3	29	5.2		
Controlled use of writing tools	Yes	591	98	549	99.3	3.391	.054
	No	12	2	4	0.7		
Keeping the pen at an adequate angle in relation to paper	Yes	584	96.8	546	98.7	4.662	.023
	No	19	3.2	7	1.3		
An adequate angle of paper	Yes	470	77.9	508	91.9	42.900	.000
	No	133	22.1	45	8.1		
No comments or complaints about pain or fatigue	Yes	463	76.8	473	85.5	14.335	.000
	No	140	23.2	80	14.5		

Observing students in relation to the literacy phase (Table 4), it was noted that students who are in the initial phase, first and second grade ones, had the greatest difficulty in placing paper at an adequate angle (22.1% of pupils), as well as in the presence of pain or fatigue while writing (23.2% of pupils), as is the case with students who had already mastered writing in which the greatest percentage was recorded for the presence of pain or fatigue (14.5% of pupils), and then problems with placing paper under an adequate angle (8.1%). The difference in the presence of difficulties in the manipulation of the tools and materials between these two groups of students was recorded in several investigated parameters, and the highest statistically significant difference was recorded in setting the paper at an adequate angle ($p = .000$) as well as in the presence of pain or fatigue ($p = .000$). These two parameters were followed by the placement of tools for writing at an adequate angle in relation to paper ($p = .023$), where significantly higher scores were achieved by students who had mastered writing skills and who were more successful in manipulating the tools and materials at writing. A statistically significant difference was not observed in the presence of difficulties in the controlled use of writing tools ($p = .054$) and in the effective stabilization of paper with the non-dominant hand ($p = .534$).

Consequently, the results show that the literacy phase is a determinant that significantly influences the manipulation of tools and materials during writing.

Discussion

The results obtained by this study show that there were statistically significant differences in the skills of manipulating writing tools and writing materials by students with and without writing difficulties, whereby students who did not encounter any writing difficulties were much more skilful in manipulation. The greatest difference was recorded in effective paper stabilization with the non-dominant hand ($p = .000$), placement of paper under an adequate angle ($p = .000$) and the presence of comments and complaints about pain or fatigue ($p = .000$). Research carried out by Rosenblum et al. (2006), points out to a significant difference between the writing characteristics of students who write skillfully or unskillfully, at the age

of eight to nine years, in terms of the width of the letters ($p = .008$), the height of the letters ($p = .005$) and the position of the pen ($p = .008$). These differences can also be explained by the fact that learners with learning disabilities, including students with writing difficulties, have lower motor performance at the joint of the wrist and the elbow joint (Stosljevic et al., 2011) in comparison to pupils without difficulties, which in turn makes it difficult to manipulate writing tools. These students also have difficulties in fine motor skills, which are reflected in the adoption of the teaching material (Levin, 1980).

Girls and boys in the highest percentage had problems with the presence of pain and/or fatigue while writing (21.8% of boys and 16.4% of girls). However, a statistically significant difference in the presence of difficulties in the manipulation of tools and materials between boys and girls was recorded in all investigated parameters, and the highest statistically significant difference was recorded in the effective stabilization of paper with the non-dominant hand ($p = .000$), and then, in the presence of the difficulty in setting paper under an adequate angle ($p = .005$). Many studies show that the gender is the determinant which affects the quality of writing (Medwell & Wray, 2007; Schweltnus et al., 2012a). Consequently, if it affects the quality of writing, it also affects the skill of writing tools and materials manipulation. Girls write faster than boys ($p = .024$) and their handwriting is more legible, and writing difficulties are more frequent ($p = .000$) in boys (Vujanovic & Ilic-Stosovic, 2017).

Students who were in the literacy process had the greatest difficulties in the presence of pain or fatigue during writing (23.2% of students), and the strongest statistically significant differences between the manipulating skills of students of the first and second grades, in comparison to the students who mastered writing, was noted in setting up paper at an adequate angle ($p = .000$) and in the presence of pain or fatigue ($p = .000$). Research shows that regardless of the time when literacy begins, the sequence of learning skills is the same. First of all, children acquire writing skills, or writing letters as patterns (van Hartingsveldt et al., 2014), when writing is conditioned not only by visual information, but also by the constant involvement of tactile and kinesthetic input, and therefore it is very important how skillfully students manipulate writing tools and materials. As the speed and readability, or the quality of writing differ depending on age (Overvelde & Hulstijn, 2011; Rueckriegal et al., 2008; Yu, et al., 2012) the skill of manipulating writing tools differs as well. Lower-class students succeed in responding to the requirements which are expected of them. However, as tasks become more complex and time-limited learners become less successfully their execution (Golubovic, 2007).

Conclusion

Based on the results obtained by evaluating the effectiveness of tools and material manipulation during writing with elementary school students, it can be concluded that the gender, the phase of literacy and the presence of difficulties in writing are determinants which affect the skill of manipulation, thus confirm the initial assumptions. Although the presence of pain and fatigue during writing (19% of students) as well as the placement of paper at an adequate angle (15.4% of students) are problems which most of the students encounter, it is noted that these problems are more obvious with students with writing difficulties and with male students, as well as students who are in the process of acquiring the writing skills.

Proper manipulation of writing tools is very important because improper manipulation can cause writing problems, or problems with the speed and legibility of writing. As a research (Kushki, et al., 2011; Richards, 2009) shows writing problems are predictors of school failure,

and therefore special attention has to be paid to this problem. Stimulation of the proper holding of the pen, at an adequate angle in relation to paper, setting up the paper under an adequate angle up to 30-35°, and its stabilization with the non-dominant hand, or the non-writing hand, are very important for the writing stage itself. A student with poor writing has a poorer position of paper due to constant changing of the angle of the paper and the inability to stabilize it with the non-dominant hand (Pollock et al., 2009).

If the student trains to properly hold and manipulate the pen, there will be a gradual reduction of pain and fatigue at writing. Students who quickly get tired at writing cannot develop the speed of writing that is intended for a given class, and therefore, trying to write faster, they write worse and their handwriting ends up unreadable. All these problems can cause difficulties in accomplishing school tasks. It often happens that teachers cannot read the written text, the students themselves get worse grades and become unsuccessful learners with low school achievement. These problems are most often characterised as disinterest and unwillingness of pupils to perform school tasks, without the assessment of their abilities and detecting the cause of writing difficulties. Uncertainty, fear and frustration are very frequent companions of students who are unsuccessful in writing, and therefore these problems also affect their functioning as biopsychosocial individuals.

In order to prevent the school failure of these students, certain intervention measures must be taken, in addition to adapting teaching materials. Henry (2000) considers that, in order to prevent school failure, measures applied at the classroom level have to be taken (teacher training in teaching skills, family connections and improved communication with parents), peer group interventions (work in small groups) and family interventions (focused on family relationships, parental skills).

Since writing is of crucial importance for life and work in modern society, not only for children at the school age, but also for adults (van Drempt, et al., 2011), the study of factors that can influence the writing skills is necessary. If, during the process of mastering writing skills, it is noted that a student is encountering difficulties, an assessment of his abilities is necessary in order to adapt the teaching process to his needs and potentials, through individualization measures or an individual educational curriculum. The engagement of a defectologist as a member of a professional team in elementary school is very important because the assessment of students' abilities should be supervised by an expert, along with the team work and engagement of all participants in the educational process.

As the results show, gender, literacy phase, and writing difficulties are determinants that affect the skill of writing tools and materials manipulation, and thus affect writing skills.

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