iejee

International Electronic Journal of Elementary Education
December 2022, Volume 15, Issue 2, 123-136

Handwriting Speeds of 4th–8th Grade Students*

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Received : 5 May 2022
Revised : 21 December 2022
Accepted : 29 December 2022
DOI : 10.26822/iejee.2023.284

* The data of this research were collected simultaneously from the sample of the study named "Development of Story Writing Skills in Primary School (1st-8th Grades)" presented by the researchers as an oral presentation at the 15th International Primary Teacher Education Symposium.

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Abstract

For the effective expression of feelings and thoughts, handwriting should be produced fluently at a certain speed. The aim of this study was to examine the development of handwriting speeds in 4th–8th grade primary and secondary school students in terms of somevariables. In line with this aim, answers were sought to the question, "Do 4th–8th grade primary and secondary school students' handwriting speeds differ significantly depending on their grade, gender, hand preference, and handwriting style?" The study was designed inthe survey method, and the study group consisted of 322 students attending the 4th, 5th, 6th, 7th, and 8th grades of primary and secondary school. A form developed by the researchers for all grade levels was usedas the data collection tool in the study. In the data collection process, the students were required to copy a given text within one minute. The research results revealed that while the primary and secondary school students' handwriting speeds differed significantly according to their grade level, gender, and handwriting style, they did not differ significantly according to their hand preferences. As the grade level increased, mean handwriting speeds also increased. Female students wrote faster than male students. Students using the manuscript handwriting style wrote faster than students who used the cursive handwriting style.

Keywords:

Handwriting Speed, Primary and Secondary School Students, Handwriting Style, Hand Preference

Introduction

Handwriting is a language skill that begins with the ability to produce letters, and it is necessary for students to be able to express themselves, their feelings, and their thoughts. As Temur, Aksoy, and Tabak maintains, "Writing begins with various scribbling and drawing activities and requires coordinated movements of the elbow, shoulder, and trunk muscles with the hand and wrist muscles" (2012, p.311). Güneş (2016) defines handwriting as a skill that requires various processes such as "holding a pencil, writing the letters, activating prior knowledge, organising, reviewing, and textualizing" (p.20). As the definitions suggest, handwriting skills entailspecific skills and stages. Tompkins et al. (2014) discuss this process in three stages: preparation for writing, starting writing, and gaining fluency. At the preparation for writing stage, children need to recognise the

units (letters, words, sentences, and texts) that make up writing (Güneş, 2007). Subsequently, an attempt is made to foster handwriting skills in students from the 1stgrade of the primary school and onwards (Ziviani & Watson-Will, 1998). According to Bara and Morin (2013), in the early stages, students must learn the shape, connections, and the direction of movement of letters. Therefore, handwriting performance requires the careful and simultaneous use of a number of cognitive (e.g., intellect, attention), sensory, and psychomotor (e.g., motor development, muscle development) behaviours (Dodd & Carr, 2003, p.128). Alongwith these behaviours, handwriting is affected by social factors such as constraints to use the right hand and environmental factors such as the literacy curriculum (Ziviani & Wallen, 2006). Handwriting quality increases more rapidly during the first years of learning and develops more slowly at later ages (Karsldottir & Stefansson, 2003). Handwriting requires cognitive effort not only for children at the beginning of the literacy process, but also for students at all grade levels (Morin, Morin, Lavoie, & Montésinos-Gelet, 2012) since writing needs to be produced fluently at a certain speed so that feelings and thoughts can be expressed effectively at all stages of learning.

A high handwriting speed is essential in terms of written communication as well as academic success (Phelps, Stembel, & Speck, 1985; Tseng & Hsueh, 1997). Young children reserve most of their cognitive energies for the motor aspect of writing (Morin, Lavoie, & Montésinos-Gelet, 2012). Therefore, in this process, for students to write accurately and fluently, teachers should pay attention not only to what students write, but also to how they write (Taylor, 2010, as cited in Başaran, 2020). When handwriting skills become more automatic, the attention and cognitive resources that are used to carry out other learning processes will mostly be used to develop the content of writing (McCutchen, 2011). Graham and Weintraub (1996) expressed this situation as children'sforgetting andnot recalling all their ideas while putting them on paperif they write slowly. In a study by Medwell, Strand, and Wray (2009) in Britain with children who finished primary school, it was revealed that handwriting, especially the ability to produce letters automatically, has an important role in text quality. If children do not produce letters at a certain speed and with a certain legibility, they cannot convert their ideas into written texts.

The aim of teaching handwriting is to enable children to produce rapid and legible handwriting (Galanis, 2008). Failure in this learning process may affect school success (Vinter & Chartrel, 2010) and may cause writing problems such as inconsistency and slowness in writing speed (Akyol, 2014).Since copying, note-taking, composition writing, and written exams are based on their handwriting ability (Bara & Morin, 2013),students with high handwriting speeds are at an advantage compared to other students when putting their ideas in writing.

Particularly in the 1st grades, children's acquisition of the skill of orderly and legible handwriting at a suitable speed is important in both educational and social sense (Yıldız & Ateş, 2010; Ziviani & Watson-Will, 1998). Therefore, legibility and writing speed are the two most important criteria in the development of handwriting (Akyol, 2008; Galanis, 2008; Graham et al.,1998). Sincethe handwriting speed is known to be directly related to students' ability to express their feelings and thoughts, it has been the subject of scientific research studies for many years. It is generally understood that letters written within a certain time period are taken into consideration for determining handwriting speed (Akyol, 2008). Freeman (1954) was the first researcher to suggest the number of letters written per minute to measure handwriting speed and create a norm (as cited in Tseng & Hsueh, 1997).

Various studies were conducted with different grade levels to assess the handwriting speeds of students. Basic findings regarding mean handwriting speeds determined in some studies withdifferent grade levels are presentedin Table 1.

In the table, the fact that the research findings show differences in mean handwriting speeds may be due

Table 1

Mean Handwriting Speeds by Copying According to Different Grade Levels

Researcher(s)	Country	Number of students	Duration (minutes)	Grade level and words per minute								
				1	2	3	4	5	6	7	8	9
Ziviani& Elkins (1984)	Australia	575	2	-	-	32.6	34.2	38.4	46.1	52.1	-	-
Ziviani (1984)	Australia	575	2	-	-	33	34	38	46	52	-	-
Phelps, Stempel, & Speck (1985)	USA	1365	2	-	-	35	46	54	66	-	-	-
Hamstra-Beltz & Blote (1990)	Germany	127	5	-	24	35	46	54	66	66	-	-
Graham et al. (1998)	USA	900	1.5	19	34	47	63	73	85	100	115	118
Temur (2012)	Turkey	75	2.5	-	-	115	-	-	-	-	-	-
Jimenez & Hernandez-Cabrera (2019)	Spain	1124	1	5	6	-	-	-	-	-	-	-
Türker & Tunç (2020)	Turkey	95	1	-	-	51	55	-	-	-	-	-
Skar et al. (2021)	Norway	4950	1.5	16	29	39	-	-	-	-	-	-

to the effect of variables such as students' individual differences, the number of students included in the sample, the country's language characteristics, and the use of different words or texts (Temur, 2012). Regarding language features, Turkish is a transparent language. Since the letter-sound relationship in transparent languages is almost standard (one sound corresponds to one letter), it facilitates the learner's acquisition and development of literacy skills. For this reason, Turkish literacy is taught and learned in a relatively short time. Moreover, it is stated that the time required to write a letter varies according to itsshape and size, and since the shapes of some letters are simple, they are easily produced,and thus, the time taken to write each letter is not equal (Güneş, 2016). Besides these, it can be said that the method used to measure handwriting speed (dictation or copying) is one of the factors causing differences in handwriting speed.

In addition to the studies above, there are also studies in which the effect of handwriting style on handwriting speed is examined. Some of these state that cursive handwriting is written faster than manuscript handwriting (Foster, 1957; Graham & Miller, 1980; Kazu & Ersözlü, 2006). In manuscript handwriting, since there is a pause after each letter, the handwriting process is interrupted and slowed. On the other hand, in cursive handwriting, since the student does not have to continue writing by frequently lifting his/her hand and finding the writing point again, his/her handwriting speed increases (Akyol, 2008; Güneş, 2006; Güneş, 2007; MEB, 2009). However, in some studies, it is revealed that while writing cursive letters, the student has to change the movement of his/her hand more (Graham,1992), and it is stated that manuscript letters are learnt more easily and written more rapidly than cursive handwriting (Bara & Morin, 2013; Berninger et al., 2006; Gates & Brown, 1929; Houston, 1938; Turan, 2010; Yıldız et al., 2016; Yıldız, 2019). Arslan and Ilgın (2010) maintained that teaching different handwriting styles could create problems for students and lead to students writing with a mixed style, which could have a negative effect on the legibility and the speed of handwriting in later grades.

In the study that they conducted with 600 students in 4th–9th grades, Graham, Berninger and Weintraub (1998) determined that there was no significant difference between beginning literacy with manuscript or cursive letters in terms of speed and legibility. Morin, Lavoie, and Montésinos-Gelet (2012) examined letter writing, word copying, and text creation skills over a 45-minute period in 715 Canadian 2nd grade students who learned literacy with different handwriting styles. It was concluded that students who learned literacy with cursive handwriting made more progress in the areas of word production and syntax than students who learned the other handwriting styles. They explained this situation by stating that in cursive writing, in contrast tomanuscript letters, all the letters of the word are interconnected, which enables students to memorise word units more easily and facilitates their recall. In a study by Bara and Morin (2013), in which they examined the handwriting speed, legibility of written texts, and handwriting styles in 4th and 5th grade students according to the handwriting style they had learnt in the 1stgrade, significant differences were found between grade level, handwriting style, handwriting teaching method, and countries. It was concluded that Canadian students wrote faster than French students, but their handwriting was less legible, the cursive handwriting speed was slower than a mixed handwriting style, and the handwriting speed and legibility improved as the grade level increased. In a study conducted with 9th grade students who had begun their first literacy education with cursive writing, Aydın (2016) determined that seeing two different handwriting styles used in class created problems for students, and this situation had a negative effect on the handwriting speed and legibility in later grades.

When other studies related to handwriting speed are examined, it is seen that variables such as gender, grade level, and hand preference are generally taken as the basis for comparisons. In their study, Graham and Weintraub (1996) reported that the relationship between handwriting speed and grade level might not always be linear. As a result of the study by Tseng and Hsueh (1997), which aimed to examine the handwriting speeds of 1525 Chinese children in 2nd–6th grades, it was reported that the handwriting speed increased with age, the rate of increase was greater among the 2nd, 3rd, and 4th grades, and girls wrote faster than boys in the 3rd, 4th, and 5th grades. In the study carried out with a total of 900 students between the 1st and 9th grades by Graham et al. (1998), it was revealed that female students wrote faster than males at the beginning and end of primary school and at the beginning of secondary school, that right-handed students wrote faster than left-handed students, and that the handwriting speed showed a tendency to increase from one grade level to another. As a result of the study conducted by Ziviani and Watson & Will (1998), in which they examined the handwriting speeds and text legibility of 372 students aged between 7–14, it was stated that there was no significant difference between the mean scores for handwriting speed in male and female students, but girls were better than boys in terms of legibility, and there was a significant difference in text legibility according to gender, while a weak correlation between speed and legibility was found. O'Mahony, Dempsey, and Killeen (2008) concluded that hand preferences of students aged 8–18 had no effect on their handwriting speed, but the handwriting speeds of students attending schools that were named as disadvantaged were below average. As a result of his study, Bay (2010) determined

that there was no significant difference between female and male students attending the 1stgrade in terms of handwriting speed. In their study examining the effect of 1st grade students' pencil holding styles, pencil gripping, and compressive strengths on their handwriting speeds and errors,Temur, Aksoy, and Tabak (2012) reported that students' pencil gripping points affected their handwriting speeds, and girls' handwriting speeds were faster than those of boys. Temur (2012) aimed to evaluate Turkish and American 3rd grade students' handwriting speeds in terms of the variables of degree of flexion of the index finger and the position of the thumb and the forearm. As a result of the study, it was reported that the degree of flexion of the index finger did not lead to a significant change in students' mean handwriting speeds, whereas the forearm and thumb position had an effect on mean handwriting speeds. Moreover, it was determined that Turkish students' handwriting speeds were higher than those of American students, and in students of both countries, girls were more successful than boys in writing skills. Aydın (2016) determined that 9th grade female students who had learnt literacy first with cursive handwriting had higher mean handwriting speeds than male students in both cursive and manuscript types of handwriting. In anotherstudy conducted with 95 students attending 3rdand 4thgrades of primary school, Türker and Tunç (2020) examined students' manuscript handwriting speeds with regard to the variables of gender, age, grade level, hand preference, statusof receiving preschool education, class type (independent or combined class), and class size. The results of the research revealed that students attending independent classes wrote faster than students attending combined classes, but no significant differenceswere foundin terms of the other variables.

The studies conducted offer different perspectives related to primary and secondary school students' handwriting speeds. O'Mahony, Dempsey, and Killeen (2008) state that handwriting speed is clearly an important factor worthy of examination on its ownbecause copying a text, taking notes, and free-writing tasks are among the most common writing tasks in school (Fogel, Rosenblum, & Barnett, 2022). Moreover, writing as a skill takes time for students. Spending too much or little time on typing tasks depends on writing speed.Hammerschmidt and Sudsawad (2004) indicated that while evaluating students' handwriting, teachers judge whether the writing is quick by comparing students with their peers. This situation makes it important to carry out this study and supports the idea that writing speed should be examined according to grade levels or age because there is no standard or norm for writing speed in terms of class levels. The statement that writing speed increases as grade level increases remainsvalidonly in theory or expectation.

When studies conducted on this subject in Turkey are examined, it is seen that they have generally been made with a single class level, e.g., with 1st grades (Bay, 2010; Duran & Akyol, 2010; Erdoğan, 2012; Kadıoğlu, 2012; Temur, Aksoy, & Tabak, 2012) and 3rd grades (Temur, 2012; Türker & Tunç, 2020). Therefore, there is a need for further research aimed at determining students' handwriting speeds comparatively. Some of the main writing tasks of students at school is answering questions in examsand classwork, such as copying from the board to notebooks or doing homework (Barnett, Prunty, & Rosenblum, 2018). Studies have stated that the inability to produce legible letters automatically and effortlessly at an appropriate speed may be an indicator that a child is at risk for developing inadequate composition skills (Berninger & Amtmann, 2003), low achievement, and low self-perception (Feder & Majnemer, 2007). Research about writing speed can inform countries about determining and controlling the variables that may affect the speed of writing (e.g., letters are produced more effortlessly in cursive handwriting, right-handed people write faster) whiledesigning curricula about language and writing skills.This study has been designed with the aim of filling the gap that exists due to this deficiency by examining the development of students' handwriting speeds with regard to severalvariables. Within the scope of the research, answers were sought to the question, "Do 4th–8th grade primary and secondary school students' handwriting speeds differ significantly depending on their grade, gender, hand preference, and handwriting style?"

Method

This study was designed as a survey method toexamine whether primary and secondary school students' writing speed is affected by variables such as grade level, gender, hand preference, and writing style. "Survey research enables to reveal what is experienced or what already exists. The researcher does not intervene in these phenomena or situations, he takes the phenomenon as it is, how it works, and examines it" (Sönmez & Alacapınar, 2017, pp.47-48).The study intended to describe the writing skills of a large sample of participants.

Study Group

Table 2

Distribution of Participating Students According to Their Gender and Grade Level

Gender	Grade Level					Total
	4	5	6	7	8	
Female	41	30	44	29	26	170
Male	33	35	27	30	27	152
Total	74	65	71	59	53	322

The study group of the research consisted of 322 students attending 4th, 5th, 6th, 7th, and 8th grades of primary and secondary schools in three state schools located in the city centres of Ankara, Trabzon, and Giresun provinces (Table 2). In order to determine the study group, the convenience sampling method was used since voluntary participants were selected in schools that could be easily and quickly accessed in the provinces where the researchers were employed. The aim of this sampling technique is to select cases where participants who are willing to take part can be included in the research according to the principle of convenience (Patton, 2014). For this reason, an effort was made to reach a certain number of students (at least 30) from each class in each grade. The reason for starting the assessment of primary school students'handwriting speeds from the 4thgrade of primary school was that the handwriting skills of students in the 1st, 2nd, and 3rd grades are still in the process of motor development. Moreover, they do not usually gain the fluencyneeded in handwriting skillsto express themselves in these grade levels yet. Students begin to organise their ideas and put them in writing more efficientlyonce they have learnt to write letters, syllables, and words legibly and correctly (Tompkins et al., 2014). They generate a writing character specific to themselves by beginning written homework, tests, and longer written exercises from the 4thgrade and onwards, whereas especially in the first three years of primary school, they are expected to acquire an adequate level of handwriting skill as a means by which they can conduct their schoolwork (Yıldız &Ateş, 2010, p.13).

Data Collection Tool

In order to determine the handwriting speeds of the students in the study, a form that was developed by the researchers was used. The form consisted of a single text for all grade levels (a paragraph taken from an informative textfor determining students' handwriting speeds), and questions related to students' grade levels, gender, and hand preferences. Tocreate the form, first,the literature was reviewed, and the criteria based on the assessment of handwriting speed were examined. Drawing upon these criteria, an informative text which was included in the primary school Turkish textbook andwhich was considered suitable to be read in schools by the Board of Instruction and Discipline of the Ministry ofNational Education was selected. While choosing the text, care was taken to ensure that the text contained a topic on which all students could meet on common ground by obtaining the views of three fieldexperts. The informative text consisted of 49 words and 314 letters which included all the lowercase letters of the alphabet at least once, with the exception of j, p, and u.

Students come across informative texts more frequently in textbooks and in their daily lives. The selected text from the Turkish textbook contains a suitable topic for all grade levels.The students were asked to copy and write the following text in the data collection form in one minute using the handwriting style they wished (SeeAppendix for its translation):

"Türkiye iki kıta üzerinde yer alan, dört mevsimin doyasıya yaşandığı cennet gibi bir ülkedir. Ülkemiz üç tarafı denizlerle çevrili, bol güneşli, birbirinden güzel sahillerini size cömertçe sunar. Bitki örtüsü ve hayvan türleri bakımından son derece zengindir. Bu topraklar camileri, kiliseleri, heykelleri, sarayları, medreseleri ile geçmişi her an yaşar gibidir."

Data Collection Process

After obtaining the necessary permission from the schools to collect the data forthe study,students in the classrooms of teachers who were able to voluntarily spare time for the research were requested to copy and write the text on the form within one minuteto determine their handwriting speeds. Before the text was written down by the students, information was given about the activity they would perform as follows:"The purpose of this study is to determine your writing speed in one minute. You can use any handwritingstyle (cursive or manuscript) you want." Students were given some time to prepare for writing, such as taking appropriate sitting positions for writing and preparing theirwriting tools.Next, with the instruction "you can start writing," the one-minute period began. At the end of one minute, with the instruction "you can stop writing," the students were asked to circle the last letter they had written and put down their pencils. In granting a period of one minute, the study by Graham et al. (1998) was taken as reference.

Data Analysis

For the analysis of the research data, descriptive statistics (percentage, frequency, arithmetic mean, standard deviation, and kurtosis and skewness values) were used to evaluate the writing speed of the students by analysingthe number of letters written per minute according to the grade levels, and two-way analysis of variance was used to determine whether there was a difference between the groups. While investigating the effect of more than one independent variable on the dependent variable, the examination of two different effects at the same time by taking into account of the interrelated interaction of independent variables and the case of interaction between variables is known as "interactive analysis of variance" (Karagöz, 2019, p.445). Accordingly, the handwriting speed of primary and secondary school students (4th–8th grades) wasthe dependent variable, and with grade levels as covariate, students' gender, hand preferences, and handwriting styles were dealt with as independent variables.

Firstly, among the total 341 student forms that were collected, 19 illegible oneswere removed from the data set. Therefore,the analyses were carried out with 322 students. The SPSS software was used in the data analysis. In the analyses made, the Cronbach alpha values of .05 and .01 were taken as the levels of significance. The suitability of the data forparametric testswas examined in terms of normal distribution (skewness and kurtosis values should be between -1 and +1). Skewness and kurtosis values between -1 and +1 are the most important indicators of mutually overlapping (equal or nearly equal) normal distribution of the arithmetic mean, mode, and the median (Can, 2013, pp.82-89). Accordingly, the arithmetic mean and the standard deviation values for the data were examined, and the skewness and kurtosis coefficients were taken into account. The measures of central tendency and normality values related to the data are presented in Table 3.

Table 3

Measures of Central Tendency and Normality Values oftheData

Grade	*n*	Lowest	Highest	*M*	*SD*	Skewness	Kurtosis
4	84	33	99	59.50	14.81	.389	-.279
5	65	25	132	76.08	25.5	.352	-.458
6	71	28	144	94.46	23.30	-.162	.121
7	59	41	159	104.63	26.78	-.007	-.479
8	53	49	161	116.79	30.11	.541	.567

Asdemonstrated in Table 3, the skewness and kurtosis values for the handwriting speeds according to grade level are between -1 and +1, and thus, thescores in the data set for the students show normal distribution (Tabacnick & Fidel, 2015). Further, the test results for the homogeneity of variance are presented in Table 4.

Table 4

Results of Levene's Test for Homogeneity of Variance

Dependent Variable	SD1/SD2	F	p
Handwriting Speed	33/288	1.22	.20

Table 4 reveals that according to the results of Levene's test for determining homogeneity of error variances, there is no significant difference between the groups in the distribution of error variances of the dependent variables (F = 1.22, p >.05), and the variances are homogeneous. In this case, to ascertain whether there is a significant difference between the mean values of handwriting speed (the dependent variable) according to the factors of the independent variables, two-way ANOVA can be performed.

Findings

In this section, the descriptive findings related to the independent variables of grade level, gender, hand preference, and handwriting style, and the two-way ANOVAfindings for mean handwriting speeds are presented by taking the research question as the basis. Before the text was copied, it was stated that students could use any writing style (cursive or manuscript) they wanted and that they had one minute to write. In Table 5, the arithmetic mean and standard deviation values for the grade level, gender, hand preference, and handwriting style variables for handwriting speed are presented.

As Table 5 shows, the general findings for handwriting speed reveals thatthe mean values related to handwriting speed increase as the grade level increases, mean values related to handwriting speed also increase. Moreover, although the speedvaries according to grade level, it can be said that girls write faster than boys, and right-handed students write faster than left-handed students. It is also striking that apart from 4thgrades, students who write with manuscript handwriting have higher mean handwriting speeds than those who write with cursive handwriting.

Following the descriptive findings, the results of the two-way ANOVA, which was performed to holistically evaluate the significance and size of the effects of the independent variables on the dependent variable, are given in Table 6.

An examination of Table 6 shows that the effect of the grade level variable on handwriting speed is significant ($F(4, 314) = 35.38$, $p < .01$) and that the effect on handwriting speed is η^2=.31. It can be said that grade level is the most effective variable, explaining 31% of the variance in handwriting speed. According to the results of Tukey's multiple comparison test, which was performed to determine in which grades this effect achieved was significant, it was determined that the difference in students' handwriting speed in the 4th grade (M = 59.50) and 5th grade (M = 76.07) was significant both between themselves and amongthe other grades. However, it was revealed that the difference between the 6th grade (M = 94.46) and7th grade (M = 104.62) and the difference between the 7th grade (M = 104.62) and 8th grade (M = 116.79) was not significant. This situation shows that handwriting speed increases from the 4th grade onwards, but the difference between some grades is not statistically significant. Furthermore, it can be seen in Table 6 that the effect of gender on handwriting speed is significant ($F_{(1, 314)}$=39.29, $p < .01$), and the effect on handwriting speed is η^2=.11. When the mean values included in Table 5 are examined, it is seen that female students' mean handwriting speeds are higher than male students' at all grade levels. This situation shows that gender is an effective variable that explains 11% of the variance in handwriting speed. It can be understood from Table 6 that another variable having an effect on handwriting speed is the handwriting

Table 5

Students' Mean Handwriting Speeds According to Grade Level, Gender, Hand Preference, and Handwriting Style

Grade		Gender		Hand Preference		Handwriting Style		Total
		Female	Male	Right	Left	Cursive	Manuscript	
4	*n*	41	33	64	10	61	13	74
	M	61.41	57.12	59.51	59.40	59.50	59.46	59.50
	SD	13.87	15.78	15.23	12.40	14.66	16.09	14.80
5	*n*	30	35	52	13	33	32	65
	M	81.50	71.42	76.69	73.61	65.42	87.06	76.07
	SD	22.97	27.05	26.06	24.18	21.84	24.72	25.56
6	*n*	44	27	62	9	13	58	71
	M	102.40	81.51	95.98	84.00	81.15	97.44	94.46
	SD	19.85	22.98	23.16	22.71	28.13	21.22	23.29
7	*n*	29	30	53	6	13	46	59
	M	120.06	89.70	106.41	88.83	91.76	108.26	104.62
	SD	19.89	24.15	26.16	29.47	24.67	26.47	26.78
8	*n*	26	27	50	3	6	47	53
	M	128.23	105.77	118.50	88.33	95.16	119.55	116.79
	SD	29.95	26.33	29.88	19.85	15.01	30.51	30.10
Total	*n*	170	152	281	41	126	196	322
	M	95.79	79.82	90.08	75.73	68.32	101.07	88.25
	SD	32.13	28.45	32.03	23.72	22.76	29.54	31.43

Table 6

Two-way ANOVA Related to the Effects of Grade Level, Gender, Hand Preference, and Handwriting Style on Handwriting Speed

Variable	Sum of Squares	*df*	Mean Square	*F*	*p*	η^2
Grade Level	68235.16	4	17058.79	35.38	.00	.31
Gender	1822.54	1	18944.61	39.29	.00	.11
Hand Preference	1822.54	1	1822.54	3.78	.06	.05
Handwriting Style	7835.69	1	7835.69	16.25	.00	.05
Grade Level x Gender	7008.92	4	1752.23	3.53	.01	.04
Grade Level x Hand Preference	2780.22	4	695.05	1.21	.31	.02
Grade Level x Handwriting Style	3639.05	4	909.76	1.68	.15	.02
Error	151370.80	314	482.07			
Total	2825142.00	322				

*p>.05

style, with an effect of $F_{(1, 314)} = 16.25$, $p < .01$. It is seen that handwriting style explains 5% (η^2=.05) of the variance in handwriting speed. When the mean values included in Table 5 are considered, students who write with a manuscript handwriting style write faster than those who write with a cursive handwriting style (at all grade levels except for the 4thgrade). However, the effect of hand preference,another independent variable of the study, on handwriting speed is not significant ($F_{(1, 314)} = 3.78$, $p > .01$). Even though it is seen that right-handed students write faster than left-handed students according to the mean values included in Table 5, this difference is not statistically significant. Based on these findings, the independent variables of grade level, gender, and handwriting style have separate, significant effects on mean handwriting speeds. When grade level is assigned as a covariate, however, it is seen that grade level and gender jointly have a significant effect on mean handwriting speeds ($F_{(4, 314)} = 3.53$, $p =< .05$), whereas grade level with hand preference ($F_{(4, 314)} = 1.21$, $p => .05$) and grade level with handwriting style ($F_{(4, 314)}$=1.68, $p => .05$) do not have a significant joint effect on mean handwriting speeds.

Discussion

As a result of this study, which was carried out with the aim of examining primary school students' handwriting speeds according to somevariables, it was concluded that 4th–8th grade students' mean handwriting speeds differed significantly depending on grade level, gender, and handwriting style, whereas they did not differ significantly according to hand preference.

The research findings reveal that primary school (4th–8th grade) students' handwriting speeds differed significantly depending on their grade level. With respect to the multiple comparison test, the difference between all the other grades was significant except forthe difference between the 6th and 7th grades, and the 7th and 8th grades, whichdid not differ significantly regarding their handwriting speed. These differences according to grade levels can be interpreted as an indication that students' writing speed development is linear as well as the fact that writing tasks at secondary school level are mostly being replaced by test and exam mindsets with less focus on writing.This also emphasises the importance of the attention paid by primary school and classroom teachers on the development of writing skills because when children reach the age of 8–10, their handwriting skills usually become automatic, and they can be used as a tool to organise their ideas well and facilitate the development of their thoughts (Julius et al., 2016). The primary school level is critical to achieve this and to acquire the ability to read and write at an appropriate writing speed. The significant difference in students' handwriting speeds in terms of grade level shows similarity with some previous studies (e.g., Graham et al., 1998; Hamstra-Bletz&Blote, 1990; Phelps, Stempel, & Speck, 1985; Skar et al., 2021; Ziviani,1984). In the study by Graham et al. (1998), in which they examined the mean handwriting speeds of 900 students between the 1st and 9th grades, it was reported that the handwriting speed showed a tendency to increase from one grade to the next. In a longitudinal study by Hamstra-Bletz and Blote (1990), in which they conducted five copying activities with 127 Dutch children in three groups, it was reported that between the2ndgrade and 6thgrade, students' mean handwriting speeds increased from 24 letters to 66 letters per minute. In a cross-sectional study conducted by Phelps, Stempel, and Speck (1985) in the USA, 1365 children were required to copy a paragraph in their own handwriting with a pencil onto unlined paper for a period of 2 minutes, and it was seen that there were significant differences in mean handwriting speeds from the 3rdgrade (25 letters per minute) up to the 8thgrade (72 letters per minute). In Australia, Ziviani (1984) conducted a cross-sectional study with 575 children who copied expressions such as "cat and dog" for a period of 2 minutes "as quickly as possible," and it was determined that between the3rdgrade and the 7thgrade, the mean handwriting speeds increased from 33 letters to 52 letters per minute and that this increase was also linear. On the other hand, the finding in the present study that handwriting continued to increase between the 6th, 7th, and 8th grades whereas the difference was not significant corresponds with the results of the study by Graham and Weintraub (1996), in which it was stated that the relationship between handwriting speed and grade level might not always be linear. Similarly, as a result of the study carried out by Türker and Tunç (2020), it was reported that the mean handwriting speeds of 3rdand 4thgrade primary school students did not differ according to the grade level variable. On the other hand in Tseng and Hsueh (1997) research that's sample group consists 1525 Chinese student between 2nd to 6th grade, pointed that speed of handwriting increase with age and reach its highest level especially at 2nd, 3rd and 4th grades. This may be due to morphological features of Chinese. According to Akyol (2008) the impact of the first years of writing learning on handwriting speed is great.Although languages such as Italian, Spanish, and Turkish are transparent, the fact that the spelling rules are easier in Turkish can provide more advantages to students in the writing process in the coming years (Jimenez & Hernandez-Cabrera, 2019).

According to the findings in the current study, primary and secondary school (4th– 8th grade) students' mean handwriting speeds showed significant differences in terms of gender. This result is in favour of female students. This situation suggests that male students should be supported more in order to be able to write at the appropriate speed in writing tasks starting from the pre-school period because unless they can master basic handwriting acquisition, they may be inadequate in writing processes that require high-level cognitive processes, such as planning what to say and how to say it, translating ideas into written text, and reviewing what has been written (Fogel, Rosenblum, & Barnett, 2022).Although the differences regarding gender that were found in this present study are supported by some previous studies in the literature (e.g., Aydın, 2016; Graham, et al., 1998; Skar et al., 2021; Temur, Aksoy, & Tabak, 2012), they differ from the findings of other studies (e.g., Bay, 2010; Türker & Tunç, 2020; Ziviani & Watson-Will, 1998). In his study related to the handwriting speeds of 9th grade students who had learnt first literacy with cursive writing, Aydın (2016) concluded that female students' mean handwriting speeds were higher than those of male students in both handwriting styles (manuscript and cursive). Moreover, in their study in which they examined the mean handwriting speeds of 900 students from the 1stgrade up to the 9thgrade, Graham et al.(1998) revealed that there was a significant difference between male students' and female students' mean handwriting speeds and that

female students in the 1st, 6th, and 7th grades wrote faster than male students. Similarly, in their study, Temur, Aksoy, and Tabak (2012) examined 1st grade students' ergonomic factors in handwriting together with the handwriting speed, and as a result, it was stated that girls' handwriting speed was greater than that of boys. In a study examining the effect of the direction of drawing letter lines on handwriting speed and the quality of letter drawing in 1st, 2nd, 3rd, and 4th grade primary school students, Başaran (2020) stated that female students drew letter lines faster than male students. On the other hand, in a study carried out with students attending the 1st grade, Bay (2010) determined that there was no significant difference in mean handwriting speeds between female students and male students. As a result of the study by Ziviani and Watson-Will (1998), in which they examined the mean handwriting speeds and text legibility of 372 children aged 7–14, it was reported that there was no significant difference between genders with respect to mean handwriting speeds. Based on the formation of handwriting skills specific to each gender, it can be said that female students are developmentally better in fine motor skills than male students (Unutkan, 2006; Başaran, 2020), and this also has an effect on handwriting speed.

The findings in the study also revealed that primary and secondary school (4th–8th grade) students' mean handwriting speeds differed significantly in terms of handwriting styles. Among the reasons for this situation, it can be thought that students in Turkey do not want to continue with cursive handwriting after primary school, that cursive handwriting is challenging/hard for them, and that they prefer manuscript handwriting with the influence of branch teachers. On the other hand, when grade level was treated as a covariate, whether students used cursive or manuscript handwriting did not have an effect on their mean handwriting speeds. Studies conducted about the effect of handwriting style on handwriting speed can be discussed as studies in which the results were in favour of manuscript letters, such as the present study, and studies in which they were not. For example, in his study examining the handwriting speeds of 9th grade students who had learnt first literacy with cursive writing, Aydın (2016) revealed that students who wrote with manuscript letters had higher handwriting speeds over a one-minute period than students who used cursive handwriting. In the study by Morin, Lavoie, and Montésinos-Gelet (2012), in which they examined letterwriting, wordcopying, and textcreation skills over a 45-minute period in 715 Canadian 2nd grade primary school students who learned literacy with different handwriting styles, it was reported that the mean handwriting speeds of students who used mixed and manuscript handwriting styles had greater mean handwriting speeds than those who used cursive handwriting. In their study, Bara and Morin (2013) examined 4thand 5thgrade students' handwriting speed, text legibility, and handwriting style according to the handwriting style they had learnt in primary school, and they stated that Canadian students wrote faster than French students, and students who used a cursive handwriting style had slower mean handwriting speeds than students who used a mixed handwriting style. On the other hand, in the present study, when the joint interaction of grade level was considered, handwriting style did not have a significant effect on mean handwriting speeds. This finding corresponds with the results of the study carried out with 600 students attending 4th–9th grades by Graham, Weintraub, and Berninger (1998), in which the use of cursive and manuscript letters did not make a difference in terms of handwriting speeds.

The findings obtained in this study also revealed that there was no significant difference in primary and secondary school (4th–8th grade) students' mean handwriting speeds with respect to their hand preferences. It did not make a significant difference to mean handwriting speeds if students wrote by using their right or left hand. In studies carried outin relation to the effect of hand preference on handwriting speed, it is striking that there are both similar and different findings. For example, in their study, in which they examined the mean handwriting speeds of 900 students between the 1st and 9th grades, Graham et al. (1998) stated that students who wrote with their right hand wrote faster than students who wrote left-handed, whereas O'Mahony, Dempsey, and Killeen (2008) reported that hand preferences (right or left) of 607 male and 617 female students, with ages ranging between 8 and 18, had no effect on handwriting speed. Similarly, when the joint interaction of grade level was taken into consideration in this current study,the fact that there was no significant difference in mean handwriting speeds between students who used their right or left hands is confirmed withthe findings of some experimental studies (Benik, 2018; Bonoti et al., 2005; Kadıoğlu, 2012; O'Mahony, Dempsey, & Killeen, 2008; Türker&Tunç,2020; Wallen& Mackay, 1999). This situation reveals that in the primary school education process in Turkey, students should not be forced to use their right hand in the first literacy process sinceusing their right hand or left hand does not affect their handwriting speed.

When the studies are evaluated in general, it is seen that there are differences between the effects of the variables of grade level, gender, hand preference, and handwriting style on mean handwriting speedsamong countries. On the other hand, the findings of this study clearly show that mean the handwriting speeds of Turkish students increase according to grade level and vary according to gender as well ashandwriting style. This situation reveals that handwriting speed is a skill that changes and continually develops

together with age, the handwriting style used in the first literacy process should be chosen carefully, and possible effects of differences between genders need to be monitored.In the learning and teaching process, students are given dictation exercises, copying tasks, or writing tasks aimed at producing content-based text. This study of writing speed may contribute to teachers in having more realistic expectations from students about the time required to complete writing tasks. Thus, teachers can have an idea about planning more effective writing activities at more appropriate times. In addition, the areas reserved for writing activities in coursebooks and workbooks can be arranged more appropriately by considering the results for writing speed according to grade level.

Limitations of the Research and Future Directions

This study is limited to 322 students attending the 4th–8th grades of primary and secondary schools in the provinces of Ankara, Trabzon, and Giresun and to the variables of grade level, gender, hand preferences, and handwriting styles for students'mean handwriting speeds. Moreover, to seta common task standard for all students in the study, an informative text was used.

Concerningthe differences in the findings for writing speed,variables such as the individual differences of the students, the number of students participating in the sample, the time, the language characteristics of the country, and the use of different words or texts may be effective (Temur, 2012). In addition, it is stated that the time required to write a letter varies according to the shape and size of the letter, and since the shapes of some letters are easier to produce because they are simple, the writing time of each letter is not equal (Güneş, 2016). Writing is a skill that requires gross and fine motor skills and should be supported in early childhood through play-based learning environments and lessons such as physical education (Patiño et al. 2020).In addition to these, it can be said that the method used to measure the writing speed (dictation or copying) is one of the factors that causes differences in writing speed. Because in a longitudinal study conducted by Gosse, Parmentier, & Van Reybroeck, (2021) with primary school 2nd,3rd,4th and 3rd,4th,5th graders, each child was given a digital tablet and a digital pen to complete a writing task (dictation). As a result of the study, they reported that handwriting speed was associated with high spelling ability and that fast handwriting was detrimental to handwriting quality. Thus, while a positive relationship was found between spelling and speed, a negative relationship was found between handwriting speed and handwriting quality. Moreover, it is seen that the studies conducted in Turkey are with the participation of one or two grade levels. However, since writingspeed is an important factor worth examining on its own, longitudinal studies with different grade levels are needed.

In this research, students' mean handwriting speeds have been examined according to differentvariables. In future studies to be conducted, legibility skills, students' socio-economic levels, and cognitive and motor factors that are directly and indirectly related to handwriting speed, such as attention deficit and muscle fatigue, can be discussed together with handwriting speed. In this way, whether factors specific to handwriting ability or whether external factors that remain beyond students' control have a greater effect on handwriting speed can be investigatedin these future studies. Furthermore, letter production alongwith motor skills in the development of handwriting skills, the role of primary school, and the effect of teaching students a digital handwriting style on handwriting speed by taking technological developments into consideration can be investigated.

Conflicts of Interest: There are no conflicts of interest.

Author Contributions: All authors contributed equally to this study.

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Appendix

"Located on two continents,Turkey is an idyllic country in which the four seasons are experienced in full. Our country is surrounded by seas on three sides, and generously offers you lovely, sun-drenched beaches. It is extremely rich in terms of its vegetationcover and animal species. These lands seem always to re-live the past with their mosques, churches, statues, palaces, and madrasas."