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Research Article

Does primary students' writing ergonomics affect their handwriting legibility?

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Abstract

The aim of this study is to examine the effect of primary school students' writing ergonomics on their handwriting legibility. Data was collected with the convenience sampling method in this study, conducted with the survey model as one of the quantitative research methods. The study sample consisted of 450 primary school students studying in the 1st, 2nd, 3rd and 4th grades of public schools in the city centre of Konya, Türkiye. The "Writing Process Observation Form" was used to determine the preferences of the students for writing ergonomics. In order to determine the handwriting legibility of the students, they were given a dictation activity, upon which their writings were analysed according to the "Multidimensional Legibility Scale". The t-test and ANOVA were used for analysing the data collected in the present study, as a result of which the handwriting legibility of female students turned out to be better than that of male students, and besides that, a statistical significance was found in terms of the grade level variable. As a conclusion, first and fourth grade students appeared to write more legibly than third grade students, and the right-handed students were found to write more legibly than the left-handed ones. However, the writing ergonomics of the students (i.e., notebook/paper positions, pencil gripping styles and pencil gripping point) seemed to have no significant impact on the legibility of the writing.

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Note(s)
[1]This study is the revised version of the paper "Do students' ergonomics preferences affect writing legibility?" presented by the researcher as an oral presentation at the 9th International Eurasian Educational Research Congress (Online), on 22-25 June 2022, İzmir, Türkiye.
[2]The ethics committee approval was obtained from Selcuk University with a document number of E.164980 on 28/10/2021.

Author(s)' statements on ethics and conflict of interest
Ethics statement: I hereby declare that research/publication ethics and citing principles have been considered in all the stages of the study. I take full responsibility for the content of the paper in case of dispute.
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Introduction

Writing is one of the basic language skills aimed to be instilled in students in primary school. It can be defined as being able to process of transferring our feelings and thoughts in our minds to paper or writing them through a mental process with the help of shapes and symbols (Güneş, 2014; Mailand, 2009). The writing skill, which is achieved by teaching certain language rules in a planned time, is the last language skill acquired. The writing skill, which takes time and effort to acquire, is the skill that students have the most difficulty with (Çamurcu,2011). The reason for such a challenge of writing is that it requires competent use of many skills concurrently, which indeed influence one another directly or indirectly, and can be considered and developed separately. As a matter of fact, during the class studies, such as copying from the board into the notebook, writing the answers in a book or a piece of paper while doing homework and writing stories (Barnett et al., 2018; Rosenblum & Gafni-Lachter, 2015), students need to incorporate these skills in the writing process.

In addition to writing the content correctly, punctuation marks, correct spelling of words, grammar, connection between paragraphs and text editing are also important in writing skills (Kellogg, 2008). Legibility, which is related to the stylistic features of the writing, is one of the issues that should be emphasized in terms of being easy to read. In the first years of primary school, more focus is placed on the legibility aspect of writing to enable the development of the shape and size of the letters. The quality of the text is also associated with legibility. As a matter of fact, the text is not legible prevents the reader from understanding the content correctly. Legibility means that one's gaze should not be locked on the writing due to form-related issues (Atasoy, 2018, p. 220). Legibility, which includes features such as the shape, size, inclination of letters, as well as spacing between letters and line tracking, is an essential element of the writing teaching process that needs to be developed along with written expression (Tok & Erdoğan, 2017). Apart from the six dimensions of legibility, factors such as slope, spacing, size, format, and line tracking are the very criteria considered in the evaluation of a legible text. In the assessment process, the fact that the letters are not written in accordance with the rules, positioned without paying attention to the line spacing, incomplete closure of the letter folds and inaccurate ups and downs can all be regarded as the factors affecting the legibility (Duran, 2009). The cases when students do not follow the rules mentioned, nor notice when they make a mistake without being checked by the teacher so that they can correct them, and when they are not given necessary feedback, may lead them to let their mistakes become a habit. Especially in the first grade of primary school, students are taught to write in accordance with the rules of writing, legibly and at an appropriate speed. For this reason, despite legibility being an important criterion in the development of writing skills (Akyol, 2011), it is indeed a critical issue that should be emphasized at every grade level. By the time children reach the age of 10, handwriting usually becomes an automatic, organized tool that will enable them to easily generate ideas (Julius et al., 2016). In order to achieve this, it is necessary that their writing is readable by others.

The relevant literature review has revealed that there are a number of studies conducted on the legibility of students' handwriting at the first grade (Aktaş & Bakkaloğlu, 2021; Gök & Baş, 2020; Okatan & Özer, 2020; Ulu, 2019) as well as those conducted with students at other grade levels (Fogel, Rosenblum & Barnett, 2022; Ghorbani et al., 2020; Schwellnus et al., 2012; Yıldız & Ateş, 2010). Besides being a factor affecting the writing skill, legibility in and of itself is also affected by some factors. It is believed that some behaviour described as the writing

ergonomics is highly likely to influence the legibility of writing. It is, therefore, necessary to teach ergonomics in the process of making students gain the necessary writing skills. The factors expressed as ergonomics of writing consist of some elements that can be listed as follows: the suitability of the writing desk and seat for the student, the surface of the writing desk, and the type of lines of the sheet of paper or notebook, paper quality, pens, posture, paper position, and pencil holding style (Taylor, 2006). In the writing process, the first attention to be paid should be on hand preference. The hand a student prefers to write with affects the pencil gripping style and notebook position. Most students write with their right hand, whereas left hand is less preferred. It is also known that approximately 10% of the population is left-handed when writing (Somers et al., 2015). Another factor that affects writing is the way of holding a pencil. The correct pencil gripping is important for the fine motor movements used to form letters in the writing process. With the generally accepted style for the ease of writing called the tripod grip (Akyol, 2011), the student grasps the pencil with the index and thumb fingers and supports it with the middle finger. The pencil grip point, in other words, the distance with the pencil is another aspect to be taken into account. The pencil gripping point should neither be too far, nor too close; 1.5-2 cm is considered sufficient (Başaran & Akyol, 2019). For left-handed students, this distance should be adjusted to see the pen tip. Another variable of the writing process is the paper/notebook position, which naturally changes according to hand preference. In this sense, right-handed students should hold the paper inclined to the right, while left-handed students should hold it slanted to the left. Research shows that teachers are models for students based on these elements in the process of teaching how to write, and that they are supposed to teach by motivating students (Graham et al., 2008; Yıldırım & Ateş, 2010).

In the relevant literature on writing ergonomics, there are studies conducted with a single grade level (Aksu & Can, 2018; Başaran & Akyol, 2019; Schwellnus, et al., 2012; Temur, 2011; Temur et al., 2011;), as well as those conducted with students at different grade levels (Yıldız et al., 2015). Some studies have examined the effect of some ergonomic factors (pencil gripping point, sitting posture, and paper position) on students' writing speed and errors (Temur et al., 2011; Temur et al., 2012), and some others (Dennis & Swinth, 2001; Schwellnus et al., 2012, 2013; Shah & Gladson, 2015) have focused on the effect of only the pencil gripping style on handwriting legibility and writing speed. The studies in which most of the ergonomic factors were discussed (Aksu & Can, 2018; Başaran & Akyol, 2019; Yıldız et al., 2015) descriptively analysed the preferences of the students for writing ergonomics. Such studies have mostly aimed to determine the extent of students' drawbacks in relation to a range of variables (pencil gripping, notebook position, sitting posture, etc.). As an example, Başaran and Akyol (2019) examined the extent to which primary school fourth grade students do movements that are not suitable for typing ergonomics during writing. In this the study, it was observed that the students made mistakes related to the pen grip. Generally speaking, studies in the literature that include ergonomic factors are intended to be descriptive. This study discusses the effect of ergonomic factors preferred while writing on legibility at all grade levels in primary school. From this standpoint, the aim of the present study is to examine the effect of primary school students' writing ergonomics (hand preference, pencil gripping style, pencil gripping point, paper/notebook position) on writing legibility. In line with this main purpose, the research questions are given below:

1. Does the students' handwriting legibility differ significantly by gender?

2. Does the students' handwriting legibility differ significantly by grade level?
3. Does the students' handwriting legibility differ significantly by hand preference?
4. Does the students' handwriting legibility differ significantly by notebook position?
5. Does the students' handwriting legibility differ significantly by pencil gripping style?
6. Does the students' handwriting legibility differ significantly by the pencil gripping point?

Methodology

Research design

This study examined the effect of primary school students' preferences for writing ergonomics (hand preference, pencil gripping position, pencil gripping point, paper/notebook position) on writing legibility, through the use of a survey, from among the quantitative research methods. Studies aiming to collect data in order to find out the determined characteristics of a specific group are called survey (Büyüköztürk et al., 2018). Survey studies generally focus on how the opinions and reactions of the study sample are distributed rather than the reasons of such opinions and reactions (Fraenkel et al., 2011).

Study sample

The study sample of this study consisted of 450 (1st, 2nd, 3rd, and 4th grade) primary school students studying in two different public schools in the city centre of Konya, by employing the convenience sampling method in order to reach the participants easily and quickly. With this sampling method, researchers choose an easy-to-reach and practical sample (Glesne, 2015). For this reason, the researcher tried to have access to a certain number of students (at least 80) at each grade level. Table 1 presents the data on the distribution of the study sample by grade levels and genders.

Table 1. Distribution of the study sample by grade level and gender

Grade / Gender	Female		Male		Total	
	f	%	f	%	f	%
1st grade	64	50.8	62	49.2	126	28
2nd grade	43	51.9	40	48.1	83	18.4
3rd grade	57	47.9	62	52.1	119	26.4
4th grade	57	46.8	65	53.2	122	27.1
Total	221	49.1	229	50.8	450	100

As shown in Table 1, the study sample comprised a total of 450 students from 1st, 2nd, 3rd and 4th grades at primary school. Approximately 51% of these students were male and 49% were female students.

Data collection tools

Multidimensional legibility scale

The scale used to evaluate the legibility of writing was developed by Yıldız and Ateş (2010). The scale consisted of three categories as "completely sufficient (3)", "moderately sufficient (2)"

and "not sufficient (1)". The criteria for legibility in the scale were set as slope, spacing, size, format and line tracking. In this direction, the students' vertical basic writings were handled separately for each sub-dimension in the study. The lowest score that can be obtained from this scale is 5 and the highest score is 15. The writings of the students according to the total score they got from the scale; It is evaluated as legible (11.8-15), moderately legible (8.4-11.7) and not legible (5- 8.3).

Writing process observation form

The "Writing Process Observation Form" developed by Yıldız and Öztürk (2013) was used to determine the students' preferences for the writing ergonomics. The reason why this data collection tool was preferred is that it has a useful structure that facilitates the determination of writing ergonomics such as holding a pencil, bodily posture and notebook positions. The form consists of two pages, the first of which present personal information and the student's preferred postures and movements, hand preference, non-writing hand position, bodily posture and notebook position. The second page of the form consists of options related to pencil gripping style and pencil gripping point, and a blank space where the researcher can write about the observation process.

Dictation texts

The primary school students were given dictation exercises in order to determine the legibility of their handwriting and to observe their ergonomic preferences in the writing process. A different text was selected for each grade level and dictation was made under the guidance of the classroom teachers. The texts used in the study included: "*Parents Started School*" for the students in Grade 1, "*Little Penguin*" for those in Grades 2 and 3, and "*Joking Elephant*" for those in Grade 4. In order to evaluate the suitability of the texts for the grade levels, the opinions of the classroom teachers and academicians working in the field of Turkish teaching were consulted. As a result of the expert opinion, 3 of the 6 texts were found appropriate on the whole and one of them was found appropriate for two grade levels.

Data collection process

Data was collected from two different public schools in the city centre of Konya in the fall semester of the 2021/22 academic year. After the necessary permissions were obtained from the schools, the classroom teachers were interviewed and informed about the content of the study. The teachers were informed that they should not interfere with the students' writing process. The researcher attended the classrooms with the classroom teacher. While the classroom teachers had the students do dictation, the researcher took photos of the students and recorded their ergonomic preferences in the writing process observation form. Following that, the dictation work of the students were collected and matched with the student observation forms. The application took approximately 1 lesson hour in each class.

Data analysis

The handwriting legibility of the students were analyzed according to the "Multidimensional Legibility Scale". Legibility criteria were scored as 3-2-1 according to the presence of the text. Normality test was performed in order to examine the conformity of the

data to the normal distribution. The kurtosis and skewness values are used as an indicator of the normal distribution. Table 2 shows the normality values of the students' legibility scores:

Table 2. Normality values for handwriting legibility scores

Variables	n	Lowest	Highest	$\bar{X}$	Sd	Skewness	Kurtosis
Legibility	450	1	3	2.18	.69	-.263	-.914

The fact that the skewness and kurtosis values are between +2 and -2 can be interpreted as a normal distribution of the data (George & Mallery, 2020, pp. 114-115.) Examination of Table 2 reveals that skewness and kurtosis values for legibility scores range between between -2 and +2 values. This shows that the data are in accordance with the normal distribution. The t-test was used to determine whether students' handwriting legibility changed according to gender and hand preference. In addition, the ANOVA test was conducted to determine whether the handwriting legibility changed according to grade level, notebook/paper position, pencil gripping style and pencil gripping point. The data were analysed using the SPSS 15.0 statistical package program. The level of significance in the questions related to the research was set to .05.

Findings

Based on the research questions, this section presents the descriptive findings related to the independent variables of grade level, gender, hand preference, notebook/paper position, pencil gripping position, and pencil gripping point, as well as ANOVA results of handwriting legibility. In the first sub-problem of the study, the t-test was conducted to determine whether the legibility of primary school students differed according to gender. The t-test results are given in Table 3.

Table 3. T-test results on the effect of gender on writing legibility

Legibility	N	$\bar{X}$	Sd	t	df	p
Male	229	10.3	2.39	-3.49	448	.00*
Female	221	11.0	2.31			

*p<.05

As seen in Table 3, there is a statistical significance on the part of female students (t (448) =-3.49; p=.00), considering the handwriting legibility scores between female students and male students. Thus, it can be concluded that female students participating in the present study wrote more legibly than their male peers.

In the second sub-problem of the study focused on whether the handwriting legibility of primary school students differed according to the grade level. Table 4 shows the descriptive findings regarding the distribution of the students' handwriting legibility scores by grade level.

Table 4. The sample size, arithmetic mean and standard deviation values regarding the distribution of students' handwriting legibility scores by grade level

Grade Level	N	X̄	Sd
1st Grade	126	11.1270	2.520
2nd Grade	83	10.2892	2.303
3rd Grade	119	10.0672	2.563
4th Grade	122	11.1230	1.918
Total	450	10.6911	2.385

The handwriting legibility scores of the students as shown in Table 4 indicate that the 1st grade students had highest average score of 11.127, followed by 4th grade students (11.123), 2nd grade students (10.289) and 3rd grade students (10.067), respectively.

Table 5 shows the ANOVA results regarding the differentiation of the handwriting legibility scores of the students in this study according to the grade level.

Table 5. ANOVA results on the variation in students' handwriting legibility scores by grade level

Source of Variance	Sum of Squares	sd	Mean Squares	F	p	Source of difference
Inter-groups	106.418	3	35.473	6.458	.000	1-3 4-3
Intra-groups	2449.646	446	5.492			
Total	2556.064	449				

*p<.05

Examination of the values included Table 5, the students' handwriting legibility scores show a significant difference in terms of grade level (F=6.458; p<0.05). According to the Tukey's multiple comparison test, conducted to determine between which groups the difference occurred, the first grade students' handwriting legibility (X̄=11.127) is significantly better than that of the third graders (X̄=10.067). In addition, it appears that the legibility scores of the fourth grade students (X̄=11.123) are also significantly higher than those of the third grade students. It is clear that as the students' grade level changes, their handwriting legibility also changes. However, there is no regular increase or decrease depending on the grade level.

In the third sub-problem of the study, the t-test was conducted to determine whether the students' handwriting legibility differed significantly according to their hand preference. Table 6 below provides the relevant t-test results.

Table 6. The t-test results on the effect of students' hand preference on their handwriting legibility

Legibility	N	X̄	Sd	t	df	p
Right hand	404	10.77	2.35	2.28	448	.023*
Left hand	46	9.93	2.52			

*p<.05

Table 6 shows that there is a statistically significant difference (t (448) =2.28; p=.02) between right-handed students and left-handed students, indicating that right-handed students

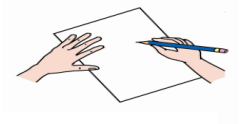
are more likely to have better legibility. It can also be seen that the students in the present study use their right hand for writing more than their left ones. It can be concluded that right-handed students write more legibly than left-handed students.

In the fourth sub-problem of the study focused on whether the writing legibility of primary school students differed according to the notebook/paper position. Table 7 demonstrates the descriptive findings regarding the distribution of the students' handwriting legibil ity score according to the notebook/paper position.

Table 7. The sample size, arithmetic mean and standard deviation values regarding the distribution of students' handwriting legibility scores by notebook/paper position

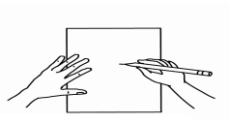
Notebook/paper positions	N	X	Sd
Position 1	146	10.9589	2.060
Position 2	5	10.6000	2.190
Position 3	290	10.5655	2.541
Position 4	9	10.4444	2.185
Total	450	10.6911	2.385

According to Table 7, although the notebook/paper positions that students prefer while writing differed, the average of the handwriting legibility score was very close to each other.

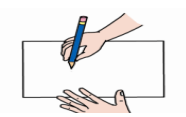


Position 1

Position 2



Position 3



Position 4

Table 8 shows the ANOVA results regarding the variation in the handwriting legibility scores of the students participating in this study according to the notebook/paper position.

Table 8. ANOVA results on the variation in students' handwriting legibility scores according to notebook/paper positions

Source of Variance	Sum of squares	sd	Mean squares	F	p
Inter-groups	15.634	3	5.211	.915	.434
Intra-groups	2540.431	446	5.696		
Total	2556.064	449			

As shown in Table 8, the notebook/paper positions that the students prefer while writing do not pose a significant difference (F=.915; p>0.05) in terms of handwriting legibility scores. It can be concluded that the change of the notebook/paper positions of the students while writing does not affect their handwriting legibility.

The fifth sub-problem of the study examined whether the handwriting legibility of primary school students showed a significant difference according to the way they were holding

the pencil. Table 9 below gives the data on the descriptive findings regarding the distribution of the students' handwriting legibility score according to the pencil gripping style.

Table 9. The sample size, arithmetic mean and standard deviation values regarding the distribution of students' handwriting legibility scores according to pencil gripping positions

Pencil holding positions	N	X	Sd
Position 1 *	130	10.7538	2.382
Position 2	135	10.4296	2.329
Position 3	38	10.3158	2.417
Position 4	29	11.1724	2.391
Position 5	73	10.7534	2.425
Position 6	10	12.1000	2.330
Position 7	35	10.9429	2.448
Total	450	10.6911	2.385

** Correct grip position*

Table 9 provides the handwriting legibility scores of the students according to different pencil holding positions; and it is seen that their averages are close to each other.

Position Position Position Position 4 Position 5 Position 6 Position 7

Table 10 shows the ANOVA results regarding the variation of the handwriting legibility scores of the students participating in the research according to the pencil gripping positions.

Table 10. ANOVA results regarding the variation in students' handwriting legibility scores according to pencil gripping positions

Source of Variance	Sum of squares	sd	Mean squares	F	P
Inter-groups	44.164	6	7.361	1.298	.257
Intra-groups	2511.900	443	5.670		
Total	2556.064	449			

As is seen in Table 10, the pencil gripping positions preferred by the students while writing did not show a significant difference (F=,1,298; p>0.05) in terms of handwriting legibility scores. It can be asserted that the students' holding the pen correctly or incorrectly while writing does not affect the legibility of the writing, so no significant relationship exists between pencil holding/gripping position and handwriting legibility.

The sixth sub-problem of the study focused on whether the handwriting legibility of primary school students showed a significant difference according to the pencil gripping point. Table 11 presents the descriptive findings regarding the distribution of students' handwriting legibility scores according to the pencil gripping point.

Table 11. The sample size, arithmetic mean and standard deviation values regarding the distribution of students' handwriting legibility scores according to the pencil gripping point

Distance with the pencil	N	X̄	Sd
Appropriate distance	175	10.7943	2.464
Close distance	258	10.6550	2.302
Long distance	17	10.1765	2.855
Total	450	10.6911	2.385

Table 11 shows that more than half of the students (258) seem to be holding the pen close to the tip while writing. Although the pencil gripping point may be different, it is clear that the students' average scores for the handwriting legibility are close to each other. The given table also demonstrates that more than half of the students' average legibility scores are close to each other.

Proper distance

Close distance

Long distance

Table 12 gives the ANOVA results regarding the variation of the handwriting legibility scores of the students participating in the research according to the pencil gripping point.

Table 12. ANOVA results regarding the variation in students' handwriting legibility scores according to the pencil gripping point

Source of variance	Sum of squares	sd	Mean squares	F	p
Inter-groups	6.701	2	3.351	.587	.556
Intra-groups	2549.363	447	5.703		
Total	2556.064	449			

As shown in Table 12, the pencil gripping point while writing did not make a significant difference (F=.587; p>0.05) in terms of handwriting legibility scores. It can be suggested that the students' holding the pen at a long distance, close or appropriate distance while writing does not affect the legibility of the text.

Discussion, Conclusion and Recommendations

In the research, firstly, it was examined whether the handwriting legibility of writing differed by gender. In this framework, it was concluded that the handwriting legibility scores of female students were higher than those of male students. In other words, the female students' handwriting turned out to be more legible than that of male students. The relevant literature review has shown that there are studies (Aktaş & Bakkaloğlu, 2021; Cordeiro et al., 2018; Demiroğlu Memiş, 2018; Gök & Baş, 2020; Graham et al., 2001; Vlachos & Bonoti, 2006) supporting the research findings of the present study. Gök and Baş (2020) examined the handwriting legibility of primary school students, concluding that female students scored higher

than male students in many dimensions of legibility as well as in overall score. Similarly, Aktaş and Bakkaloğlu (2021) examined the handwriting legibility and writing errors of students who learned to read and write during the pandemic period and reported that female students were able to write more legibly than male students. However, research also shows that gender differences do not affect the legibility of writing (Ghorbani et al., 2020; Schwellnus et al., 2012; 2013). As an example, Ghorbani et al. (2020) examined the writings of primary school students in terms of legibility and speed, and as a result of the research, they concluded that the gender variable did not make a difference in handwriting legibility and writing speed, a result contrasting with that of the present study.

The second sub-problem of the study focused on whether the handwriting legibility changed according to the grade level. According to the results obtained, it appeared that the 1st grade students achieved the highest writing legibility score, while the 3rd grade students received the lowest score. As a result of the analysis conducted on revealing on which grade levels handwriting legibility made a difference, it was evident that the handwriting legibility of the first grade students was significantly better than that of the third graders. In addition, the legibility scores of the fourth grade students were also significantly higher than those of the third grade students, signifying that the students' handwriting legibility was likely to change in line with the grade level. However, there was no regular increase or decrease depending on the grade level. In this context, Graham et al., (1998) likewise concluded that the relationship between grade level and legibility was not linear. Tok and Erdoğan (2017) also examined the handwriting legibility of primary school students, stating that legibility did not improve according to the grade level. On the other hand, Kusdemir et al. (2018) reported that as the grade level increased, the handwriting legibility of the students decreased, and that the second grade students' handwriting proved more legible than that of the fourth grade students.

According to another result of the present study, the hand preference of the students affected their handwriting legibility, and 10% of the students participating in the study used their left hand and 90% used their right hand while writing. This ratio of hand preference is similar to other studies found in the relevant literature (Schwellnus et al., 2012; Somers et al., 2015). In the current study, the right-handed students proved to have developed a more legible handwriting than that by the left-handed students. This result of the study differs from what was reported by Özer and Bağcı (2018), who examined the handwriting legibility of the students from 2nd to 7th grade according to various variables, concluding that the handwriting legibility of the students did not differ significantly according to the hand used, but that the left-handed students' handwriting was more legible. In a study conducted by Graham et al. (1998), in which 900 students from first grade to ninth grade were examined in terms of writing legibility and writing speed, the authors stated that hand preference had no effect on handwriting legibility. This difference in the results of the research may be due to the fact that the writing skill is unique to each student in addition to the existence of differences in the study samples.

The fourth sub-problem of the research aimed to examine the impact of the students' notebook/paper positions on their handwriting legibility. In this study, more than half of the students seemed to hold the paper in a perpendicular position to their body, followed by the right-handed students who held it in the appropriate position. Similarly, Yıldız et al. (2015) examined the ergonomics preferences of primary school students, concluding that nearly half of them held the paper in an upright position and nearly half in a horizontal position to the right.

Temur et al., (2011) also reported similar results regarding paper holding positions in their study conducted with first-year primary school students.

According to the results, although the notebook/paper positions that the students preferred while writing differed, it was seen that the average score of their handwriting legibility was very close to one other with no statistically significant difference. In another study, Özer and Bağcı (2018) concluded that the legibility scores of the students changed according to the way they held the paper, and the students who held the paper inclined and horizontal had higher legibility scores compared to those holding the paper upright. This result differs from those of the present study.

The fifth sub-problem examined the effect of the students' pencil gripping positions on the legibility of writing. It appeared that the pencil holding positions preferred by the students while writing did not show a significant difference in terms of handwriting legibility scores. In other words, it can be asserted that students' holding the pen correctly or incorrectly while writing does not affect the legibility of the writing. The literature review points to a number of studies supporting the results of the present study (Dennis & Swinth, 2001; Donica, et al., 2018; Koziatek & Powell, 2003; Schwellnus et al. 2013; Shah & Gladson, 2015). Moreover, Donica, Massengill, and Gooden (2018) examined the relationship between first and second grade students' pencil gripping and handwriting legibility, reporting that the students' pencil holding styles did not have a significant effect on their legibility scores. Koziatek and Powell (2003) studied on the influence of pencil gripping styles on speed and legibility in children's cursive handwriting skills and concluded that pencil gripping styles did not have a significant effect on speed and legibility. Similarly, Dennis and Swinth (2001) reported that the way of holding the pencil did not have a significant effect on legibility in both short and long writing tasks.

Finally, the effect of the pencil gripping point on the legibility of the writing was examined in the study, and it turned out that more than half of the students were holding the pencil close to the tip while writing, followed by those students holding the pencil at the appropriate distance as the second majority group. Yıldız et al. (2015) stated that three-quarters of the students were in the habit of holding the pencil close to the tip. On the contrary, the study conducted by Temur et al., (2011) concluded that two-thirds of the students kept the pencil at an appropriate distance, while a few of them tended to hold the pencil close to the tip. The authors also reported that the average scores for the handwriting legibility of the students were close to each other, although the pencil gripping point was different. It was observed that the pencil gripping point while writing did not make a significant difference in terms of students' handwriting legibility scores. It can, therefore, be suggested that the students' holding the pencil at a long distance, at a close distance or at an appropriate distance while writing does not affect the handwriting legibility.

Generally speaking, the results of the study revealed that the writing ergonomics preferred by the students have no impact on their handwriting legibility. In this respect, it can be asserted that the preferred writing ergonomics do not make a significant difference regarding the quality of writing, a situation that necessitates reconsidering teaching ergonomic skills or their importance. Ergonomics should be deemed important not because they will contribute to the academic performance of students, but because they enable students to feel more comfortable and less tired in the writing process, and to not develop a negative posture. Thus, providing

students with the right ergonomic behaviours should continue to be on the agenda of teachers as a requirement of pedagogy.

In line with the results obtained, the following suggestions can be made to shed light on future studies: The effects of students' preferences for the writing ergonomics on different variables such as writing attitude, motivation or the effect on writing performance, as well as written expression skills can be further investigated. By conducting qualitative studies, more detailed information can be explored about the wrong ergonomics preferences of students. Future studies can be conducted in terms of the effects of correct and incorrect writing ergonomics on attention and concentration skills, and on the use of muscle strength in the writing process. Considering that preschool is the period of preparation for literacy, further research can be done on the writing ergonomics in preschool. In the relevant literature, many studies have been carried out in an effort to determine the current situation regarding the ergonomics preferences of students. In this connection, future studies may focus on the knowledge level of classroom teachers on writing ergonomics.

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