

# Research Paper: Relationship Between Teacher's and Therapist's Evaluations on Handwriting Performance in First-grade Children



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## ABSTRACT

**Objectives:** Handwriting dysfunction may harm children's wellbeing. Therapists and elementary school teachers help to identify and improve children's handwriting performance. The present study aimed to assess the relationship between therapists' assessment and teachers' perception of handwriting performance in first graders.

**Methods:** This cross-sectional study involved (n=31) first-grade students, aged 6-8 years from an international school in Riyadh City, Saudi Arabia. Teachers evaluated the handwriting proficiency using the Handwriting Proficiency Screening Questionnaire (HPSQ), and the explored students were rated as proficient and non-proficient hand writers. Furthermore, therapists assessed students' handwriting proficiency using the Minnesota Handwriting Assessment (MHA) (manuscript & D'Nealian styles) scores. The Mann-Whitney U test was used to assess the differences in MHA scores between proficient and non-proficient hand writers. Moreover, Spearman's correlation coefficient was used to assess the relationship between the scores of MHA and HPSQ.

**Results:** There was a significant difference in all component scores of MHA (except the rate) and both writing styles between the proficient and non-proficient writers ( $P < 0.05$ ). There was also a significant relationship between the MHA and the HSPQ scores ( $P < 0.05$ ). However, further analysis of these scales' components suggested no significant association between teachers' and therapists' evaluation of the handwriting speed domain.

**Discussion:** There was a significant relationship between the teacher's and therapist's evaluation of handwriting performance using standardized measures. Thus, therapists should work in collaboration with teachers to identify and treat handwriting difficulties in school children.

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## Highlights

- The present research highlighted the association between occupational therapists and elementary school teachers' handwriting performance assessment in school-age students.
- There was a significant difference in all component scores of the Minnesota Handwriting Assessment (MHA), except the rate component, and both writing styles of MHA between the proficient and non-proficient writers.
- There is a moderate relationship between teacher and therapist rating of handwriting in elementary school children.
- Therapists may work in collaboration with school teachers to identify handwriting difficulties in school-age children.

## Plain Language Summary

Handwriting problems are a severe burden to academic learning purposes in elementary school children. The adverse effects of handwriting difficulties can lead to decreased academic performance. This condition presents severe consequences on emotional wellbeing and social functioning in children. Therapists and school teachers play a critical role in identifying handwriting dysfunction in children. The collected results provided insights related to elementary school teacher's and therapist's evaluation of handwriting performance using standardized measures. Therefore, therapists should work in collaboration with teachers to identify and treat handwriting difficulties, including legibility. The study findings may help teachers and healthcare providers understand the importance of handwriting components.

### 1. Introduction

Although the flow of technological changes in education, handwriting is considered an indispensable tool in the elementary curriculum. The International Classification of Functioning, Disability, and Health (ICF) recognizes the handwriting as a necessary skill for learning and applying knowledge [1]; learning to write a primary task in childhood constitutes 30%-60% of school day activities [2, 3]. Empirical evidence indicated that 10%-30% of schoolchildren failed to develop efficient handwriting [4].

Handwriting difficulties are regarded as severe hindrances to education learning for elementary school children. Teachers or parents, whose primary concern is child handwriting, especially about the legibility and speed domain, make most referrals to the therapists [5]. The adverse effects of handwriting difficulties can lead to more unsatisfactory academic performance. Besides, this condition may present severe consequences on emotional wellbeing and social functioning [6, 7]. To prevent these adverse effects on child development, Occupational Therapists (OTs), in collaboration with teachers and other educational team members, should identify and support the students with writing difficulties in improving their handwriting performance [8].

Elementary-School children with legibility problems may be guided by teachers at school or referred to an OT for further evaluation [9, 10]. One of the most common reasons for OT consultations in school settings is poor academic performance due to handwriting difficulty. OTs work with students to improve their academic skills [11]. In Saudi Arabia, class teachers are responsible for identifying students with writing difficulties and referring them to special education teachers. Students with learning disabilities are educated in the general education curriculum, and extra support (e.g., a resource room) is available when necessary [12]. However, assessment measures for handwriting difficulties in the school-based setting are lacking [13, 14]. Researchers believed that teachers subjectively assess students' handwriting instead of using a standardized handwriting test [15].

Therapists and researchers need to comprehend the association between the assessed and the actual execution in real-life contexts, such as home or school settings [16]. A common understanding is mandatory in what constitutes legible handwriting between teachers and OTs [17]. However, the agreement between teacher and therapist evaluation ranged from 21% to 36% [15]. Handwriting experts indicated that early identification and improvement in children's handwriting skills rely on teachers who regularly interact with the students daily. Understanding teachers' opinions and perceptions in evaluating handwriting and their measures to determine

the handwriting quality for referring children to an OT is critical. Such measures help to reduce learning disabilities and enhance academic performance. The literature suggested that teachers rarely used standardized assessment tools; they subjectively assessed their student's handwriting through visual analysis [15, 17].

The handwriting evaluation and assessment procedures are based on informal processes and lack evidence-based, reliable, and valid judgment. The main relevant reasons were that teachers overlooked adopting the standardized tools for assessing handwriting; instead, they further focused on instruction programs. Secondly, there was no emphasis on handwriting evaluation and exposure to handwriting measurement techniques in teacher training programs or field settings. The classroom teacher is responsible for the children's handwriting; however, school psychologists and OTs play an essential role in assessing and managing handwriting difficulties [18]. Empirical evidence suggested that teachers' handwriting assessments may not be congruent with those obtained from standardized handwriting measurement tools. For example, the tools that OT practitioners use when evaluating handwriting [15, 16]. Thus, therapists must understand the real-life context when the therapy results are analyzed. Furthermore, they must consider the subjective opinions and teachers' judgment. Variations in teachers' and OTs' handwriting quality assessments may put the child at risk; consequently, children may not be treated for handwriting difficulty, which may further impact their academic performance [15].

Several assessment tools are available to measure children's handwriting legibility [4, 14, 19-22]. OTs use the Minnesota Handwriting Assessment (MHA), a reliable and valid tool, to identify students with handwriting difficulties and document treatment effectiveness [23]. Teachers use the Handwriting Proficiency Screening Questionnaire (HPSQ) to assess handwriting quality. The HPSQ is also a valid and reliable (respecting inter-rater and intra-rater) measure [23]. However, research on the extent of agreement between the MHA and HPSQ handwriting assessment tools remains scarce.

Teacher's and therapist's handwriting assessment is crucial in identifying and managing handwriting difficulties; in this pilot study, we aimed to examine the extent of association between OT's evaluation (the MHA scores) and the school teacher's assessment (the HPSQ scores) concerning children's handwriting performance.

## 2. Methods

This cross-sectional study was conducted among first-grade students (N=31; 16 boys, 15 girls) aged 6-8 years from the British International School from December 2018 to June 2019. Typically-Developing school children were invited to participate in our study. Children with delayed development, any chronic neurological illness, intellectual disabilities, uncorrected visual problems, and any other conditions that affect cognitive function were excluded from this research. The Research Ethics Committee of the College of Applied Medical Sciences (Code: CAMS 35-34/35) and the School authorities approved the current study. Teachers evaluated the examined students' handwriting proficiency using the HSPQ; subsequently, based on the obtained scores, the students were classified as proficient and non-proficient groups. Furthermore, therapists evaluated the students' handwriting using MHA (both styles). All study participants were requested to copy words from the pre-printed test sheets of MHA (standard & D'Nealian). The following tools were used in this study:

**The Handwriting Proficiency Screening Questionnaire (HPSQ):** It consists of 10-items and 3 domains, as follows items 1, 2, and 10 for legibility; items 3, 4, and 9 for performance time; items 5-8 for physical and emotional wellbeing. Each item is scored on a Likert-type scale from 0 (never) to 4 (always); higher scores indicate poor performance. Based on a previous study, children who received a final score of  $\geq 14$  were considered non-proficient writers, while those with a score below 14 were considered proficient hand writers [14].

**The Minnesota Handwriting Assessment (MHA):** It is a standard and clinician-rated instrument intended for administration by OTs. The MHA assesses writing legibility and speed in near-point copying. Students have to copy a standard sentence (e.g., "the quick brown fox jumped over the lazy dogs"), and it has alphabets A-Z. If a student fails to complete the task in 2.5 minutes, extra time is given to complete copying. Then, the copied sentence is assessed for rate and quality scoring. The rating score is assessed in the initial two and half minutes as soon as the timer starts. The quality score assesses legibility, form, alignment, size, and spacing. The composite MHA scores have excellent inter-rater and intra-rater reliability [23]. The MHA has good face validity [22], content validity [11, 24], and construct validity [20, 25, 26]. Based on the rate and quality scores, the handwriting performance of the first-grade students can be measured. Performance is categorized as follows: performing like peers: students in top 75% of the final sample

scores; somewhat below peers: students ranged 5%-25% of the sample, and well below peers is for those who fall under 5% of the sample.

The study participants were selected from the British International School in Riyadh City, Saudi Arabia. The first-grade children were randomly selected from different class sections. The school authorities informed all the participants' parents, and informed consent was obtained from them. We met all the explored student' teachers on a one-to-one consultation to discuss the best time to collect the data; they were also informed about the study purposes. We conducted a practice session for them on how to assess handwriting using the HSPQ. Therapists assessed handwriting performance using the MHA. In a distraction-free environment, the examined students were seated at the appropriate height for their size. Each child was explained on copying the sentence on a sheet for both handwriting styles (manuscript & D'Nealian-style). The copied sentence was scored for rate and quality. The error rate per category was scored, and the maximum possible score equals 34. The number of letters completed in two and half minutes is the rate/speed score [27]. Later, teachers assessed handwriting proficiency using the HSPQ and the explored students were divided into proficient (scores <14) and non-proficient hand writers (scores ≥14). Students having difficulty reading (dysgraphia) were identified by their teachers based on the cut-off scores of the HPSQ.

The difference between proficient and non-proficient handwriting in the MHA was calculated using the Mann-Whitney U test, and the association between the MHA and HSPQ scores was assessed using Spearman's correlation coefficient. SPSS was used for data analysis.

### 3. Results

Thirty-One first-grade children (16 boys, 15 girls) participated in this study with a Mean±SD age of 73±4 months. Twenty-Seven participants were right-hand dominant. The study participants' descriptive data of MHA scores for both manuscript style writing and D'Nealian style writing are presented in Table 1. Besides, the obtained HPSQ scores are listed in Table 2.

A significant difference between proficient and non-proficient writers was observed in all the MHA components, except rate ( $P<0.05$ ). The total scores between proficient and non-proficient hand writers indicated significant differences for both the styles; manuscript style ( $U=33.5$ ,  $P<0.05$ ), and D'Nealian Style ( $U=31.5$ ,  $P<0.05$ ). However, there was no significant difference in the rate domain

between the styles; manuscript style ( $U=98$ ,  $P>0.05$ ) and D'Nealian style ( $U=112$ ,  $P>0.05$ ) (Table 3).

There was a moderate agreement between the MHA manuscript and the HPSQ ( $r=-0.65$ ) using Spearman's correlation coefficient. However, there was no significant association between the rate domain and the HPSQ's total scores. No significant difference was observed between MHA domains (legibility, form, size, spacing, & total score) and the HSPQ performance, time domain (Table 4).

There was a strong association between the total D'Nealian score and the HPSQ scores ( $r=-0.72$ ). Similar to the manuscript style, the rate domain revealed no association with all the three domains of HPSQ. Furthermore, all the MHA domains were not correlated with the performance time domain of the HPSQ (Table 5).

### 4. Discussion

This study provided insights related to the elementary school teachers' and therapist's evaluation of handwriting performance using standardized measures. The level of agreement of handwriting performance between therapists' and teachers' evaluation suggested the following data: a moderate correlation between all the MHA domains (manuscript style) and the total scores of HPSQ; a strong association between MHA (D'Nealian script style) and HPSQ; no association between the MHA rate domain (manuscript & D'Nealian styles) and HPSQ scores. The study findings may help teachers and healthcare providers understand the importance of the components of handwriting.

Hammerschmidt and Sudsawad found that 89.5% of teachers subjectively assessed the students' handwriting performance by comparing them with their peers and never used an evidence-based tool [17]. Contrarily, teachers in our study used a standardized tool (the HSPQ) for handwriting performance measurement instead of a subjective legibility assessment.

The obtained data revealed the non-proficient hand writers performed significantly poorer on all MHA variables, compared to their peers, except in the rate domain. Irrespective of the style of handwriting, the speed/rate of handwriting scores did not differ. However, the other MHA domains presented a significant difference between proficient and non-proficient hand writers. This finding was in line with those of previous studies, outlining the speed/rate score was not a primary outcome. This is because it was challenging to find the relationship between slow and fast handwriting speed and the quality of

**Table 1.** Detailed MHA scores of the study participants

Variables		Mean±SD	95%CI	PLP	PSBP	PWBP
Rate	Manuscript	20.90±7.30	18.23-23.58	12	14	5
	D'Nealian	22.74±7.56	19.97-25.51	17	11	3
Legibility	Manuscript	26.74±8.16	23.75-29.74	13	3	15
	D'Nealian	30.68±4.64	28.98-32.38	14	2	15
Form	Manuscript	21.81±8.22	18.79-24.82	5	7	18
	D'Nealian	25.39±6.62	22.96-27.82	8	13	10
Alignment	Manuscript	13.52±11.58	9.27-17.76	4	6	21
	D'Nealian	15.06±11.45	10.87-1.26	4	7	20
Size	Manuscript	16.74±12.65	12.10-21.38	12	5	14
	D'Nealian	19.81±11.82	15.47-24.14	13	8	10
Spacing	Manuscript	25.68±8.16	22.68-28.67	16	3	12
	D'Nealian	28.48±5.50	26.47-30.50	19	4	8
Total	Manuscript	125.39±41.73	110.08-140.69	6	9	16
	D'Nealian	142.16±33.39	129.91-154.41	6	15	10

PLP: Performing Like Peers; PSBP: Performing Somewhat Below Peers; PWBP: Performing Well Below Peers; CI: Confidence Interval

handwriting [27]. As per the literature, legibility, form, space, alignment, and size were the most frequently identified contributing factors to writing quality and provided significant variation. To assess the alignment, size, and spacing domains, the visual skills and spatial orientation of the writing surface are mandatory for alignment, size, and spacing categories [24].

The level of agreement of the MHA manuscript and D'Nealian styles and the HPSQ indicated some interesting findings. There was no relationship between the MHA rate domains and the total scores of the HPSQ in both writing styles. However, there was some extent of

association between legibility and performance time domains of the HPSQ in manuscript style and none in the D'Nealian style. In other words, improvements in other handwriting categories must be emphasized to promote handwriting rate rather than vice-versa, which can be detrimental to the other variables. All the other domains of the MHA manuscript and D'Nealian were significantly and reversely correlated with the total scores of the HPSQ. In contrast to our findings, a previous study addressed a lack of agreement between the children's handwriting assessment measure and the teachers' perceptions of handwriting legibility in general and specific writing tasks [16].

**Table 2.** Detailed HPSQ scores of the research participants

Domains	Mean±SD	95%CI
Legibility	3.94±3.32	2.72-5.15
Performance Time	4.81±2.24	3.98-5.63
Physical Emotional	5.58±4.77	3.83-7.33
Total	14.32±8.75	11.11-17.53

CI: Confidence Interval

**Table 3.** Differences between proficient and non-proficient handwriting in the MHA

Variables	Mean Rank		U	
	Proficient Handwriting (n=17)	Non-proficient Handwriting (n=14)		
Rate	Manuscript	14.76	17.5	98 <sup>ns</sup>
	D'Nealian	15.59	16.50	112 <sup>ns</sup>
Legibility	Manuscript	19.97	11.18	51.5*
	D'Nealian	20.71	10.29	39*
Form	Manuscript	20.24	10.86	47*
	D'Nealian	20.65	10.36	40*
Alignment	Manuscript	20.35	10.71	45*
	D'Nealian	19.68	11.54	56.5*
Size	Manuscript	20.56	10.46	41.5*
	D'Nealian	20.82	10.14	37*
Spacing	Manuscript	19.85	11.32	53.5*
	D'Nealian	20.94	10.00	35*
Total	Manuscript	21.03	9.89	33.5*
	D'Nealian	21.15	9.75	31.5*

\* P<0.05; <sup>ns</sup> P>0.05; U: Mann-Whitney U test

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Another finding of our study was the moderate agreement between teachers and therapists on handwriting assessment. This finding may be attributed to the subjective nature of the HPSQ scale, while the MHA scale is norm-referenced. The teacher's assessment included factors that influence the evaluation of handwriting

skills, as the HPSQ scale encompassed the personal and emotional wellbeing domain, i.e., not included in the therapist scale. The components that teachers considered to be more important may not necessarily associate with the findings of therapists' perspectives. The other explanation could be that the MHA is a one-time evaluation

**Table 4.** Correlation between the MHA manuscript style and the HPSQ style

MHA	HPSQ			
	Legibility	Performance Time	Physical & Emotional	Total
Rate	0.366*	0.385*	0.121 <sup>ns</sup>	0.231 <sup>ns</sup>
Legibility	-0.538*	-0.251 <sup>ns</sup>	-0.560*	-0.589*
Form	-0.585*	-0.337 <sup>ns</sup>	-0.506*	-0.574*
Alignment	-0.659*	-0.361*	-0.559*	-0.612*
Size	-0.568*	-0.329 <sup>ns</sup>	-0.548*	-0.551*
Spacing	-0.450*	-0.157 <sup>ns</sup>	-0.522*	-0.534*
Total	-0.602*	-0.275 <sup>ns</sup>	-0.641*	-0.654*

\* P<0.05; <sup>ns</sup> P>0.05

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Table 5. Correlation between the MHA D'Nealian and HPSQ scores

MHA	HPSQ			
	Legibility	Performance Time	Physical & Emotional	Total
Rate	0.176 <sup>ns</sup>	0.199 <sup>ns</sup>	-0.070 <sup>ns</sup>	0.012 <sup>ns</sup>
Legibility	-0.609*	-0.120 <sup>ns</sup>	-0.691*	-0.669*
Form	-0.700*	-0.282 <sup>ns</sup>	-0.636*	-0.681*
Alignment	-0.640*	-0.315 <sup>ns</sup>	-0.516*	-0.582*
Size	-0.690*	-0.346 <sup>ns</sup>	-0.648*	-0.676*
Spacing	-0.611*	-0.239 <sup>ns</sup>	-0.642*	-0.637*
Total	-0.728*	-0.301 <sup>ns</sup>	-0.707*	-0.728*

\*P<0.05; <sup>ns</sup>P>0.05

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of handwriting performance; however, the teacher's questionnaire score represents a general observation of the skills over time. The MHA evaluation was performed in a structured format in an artificial setting, in contrast to teacher evaluation, i.e., conducted in more natural settings. Apart from these reasons, other characteristics, such as motivation and personal problems may affect handwriting performance.

Evaluating students' handwriting performance through standardized scales measures the actual outcome in social context rather than therapeutic or research outcome. Therefore, improving handwriting skills can be achieved by considering the teacher's specifications while the therapist sets the goals to improve handwriting difficulties. Although this study adds value to the literature, there were a few limitations. First, the sample selection was among the significant limitations of the study. Another limitation was the study sample, i.e., a convenience sample instead of a random one. Thus, the study results can be generalized to students in international schools with English as their medium of instruction.

## 5. Conclusion

There was a level of agreement between the teachers' and therapists' ratings on handwriting proficiency of the examined first-grade students in all the explored components, except the MHA scale rate category. The standardized and evidence-based tools for evaluating elementary school children's handwriting performance can help accurately assess handwriting difficulties. A better level of agreement between teachers and therapists can be achieved through collaboration, communication, and

teamwork with a common goal to improve handwriting performance.

## Ethical Considerations

### Compliance with ethical guidelines

The Research Ethics Committee of the College of Applied Medical Sciences, King Saud University (Code: CAMS 35-34/35) and the School authorities approved the study.

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### Authors' contributions

Conceptualization and Supervision: Adel Alhusaini and Ganeswararao Melam; Methodology: Syamala Buragadda, Emad Bakr Takrouni, Faizan Zaffar Kashoo; Investigation, Writing – original draft, and Writing – review & editing: All authors; Data collection: Ganeswararao Melam and Emad Bakr Takrouni; Data analysis: Adel Alhusaini and Ganeswararao Melam.

### Conflict of interest

The authors declared no conflicts of interest.

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