Script Struggles: A Psycholinguistic Study of Handwriting Difficulties among EFL Learners

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Abstract

This study seeks to examine the salient manifestations of handwriting difficulties experienced by learners of English as a Foreign Language (EFL), throwing light on the cognitive, neural, and educational aspects of handwriting. Qualitative and quantitative research designs were adopted to provide a comprehensive understanding of the manifestations of handwriting difficulties among EFL learners. In total, 80 college-level EFL students aged between18 to 22 years were included in this study. To investigate the specific manifestations of handwriting difficulties faced by the EFL learner population, data were gathered using a handwriting task given to all participants. The results of this investigation showed that the participants performed less than optimally in key handwriting features, including letter size consistency, legibility, word spacing, letter spacing, letter shape, left margin, and writing speed. Based on the findings, the study concluded with proposed interventions and instructional strategies to enhance the legibility and fluency of EFL learners' handwriting.

Keywords: handwriting difficulties, manifestations, cognitive factors, interventions, EFL learners

1. Introduction

1.1 Background of the Study

Handwriting is a crucial component of language learning and communication (Jaashan et al., 2023). It is "language by hand", as it is described by Berninger, (2000), which involves a sophisticated integration of fine motor abilities with various cognitive processes (Van Galen, 1991). Handwriting is seen as a unique linguistic art of tremendous significance, as it enables individuals to communicate effectively in a wide range of linguistic settings and extends communication beyond vocal interactions through the physical production of symbols and gestures on paper (Crouch & Jakubecy, 2007). Additionally, handwriting holds a significant value in professional settings as well, as it allows individuals to express ideas consistently and professionally through written language. This competence demonstrates a dedication to professionalism critical thinking, while also promoting cross-linguistic idea exchange and inclusivity in communication (Brunswick et al., 2010). This highlights the critical role of efficient handwriting, which extends beyond the personal realm and holds important implications for successful academic and professional achievements.

From a pedagogical perspective, research suggests that handwriting is crucial for the development of cognitive functions and motor skills (Graham et al., 1997). Efficient handwriting is generally acknowledged as a prerequisite for future academic success since it increases students' motivation and self-esteem while also encouraging their active participation in class activities (Engel-Yeger et al., 2009; Volman et al., 2006). Recognizing the importance of handwriting as a multifaceted skill that requires gradual development (Barnett et al., 2007; Graham et al., 1998), many experts have emphasized its significance in early education as it contributes to the overall development of writing (Connelly et al., 2012), spelling (Graham et al., 1997), and reading (Guan et al., 2015). In spite of its significance, handwriting continues to be a neglected aspect in education, although it constitutes a subject of extensive research within the realm of literacy activities (Medwell & Wray, 2007). Consequently, it is essential to emphasize the importance of proficient handwriting skills in both academic and professional settings, especially in an era where technology increasingly dominates the educational process.

In line with this perspective, Richards (1999), highlighted the role of handwriting skills in helping students to effectively communicate their ideas and thoughts, and knowledge in written form. Legible handwriting plays a crucial role in enabling teachers and peers to accurately understand and evaluate students' written work. Additionally, Volman et al. (2006) emphasized that proficient handwriting is among the essential academic skills that children must acquire to meet the standard requirements of primary school classroom activities.

Generally speaking, clear and intelligible handwriting significantly contributes to the readability of assignments, exams, and in-class activities. It also contributes to effective note-taking and helping students capture essential information during lectures and study sessions at university (Connelly, et al., 2005; Jaashan et al., 2023; Mueller & Oppenheimer, 2014). Thus, students with handwriting difficulties may face challenges in higher-level writing tasks, such as note-taking and expressing their knowledge, ultimately resulting in a negative impact on their language learning development (Crouch & Jakubecy, 2007; Jaashan et al., 2023).

Of late, an increasingly large amount of research has focused on the negative impact of handwriting difficulties on students' academic performance. It has been documented that handwriting difficulties can make it challenging for students to complete written assignments and exams within the given time frame. Slow and laborious writing can limit the amount of content they are able to produce (Crouch & Jakubecy, 2007; Ukwueze, 2015). Moreover, illegible handwriting can hamper the ability of teachers to read and understand students' written work, resulting in difficulties in assessing and grading their performance accurately (Crouch & Jakubecy, 2007; Jaashan et al., 2023). Besides, in collaborative learning settings, illegible handwriting can pose challenges for peers in understanding and providing constructive feedback on each other's work, limiting the effectiveness of these collaborative interactions. Accordingly, lack of proficiency in developing a rapid and legible handwriting style puts students at a disadvantage, thereby increasing the likelihood of academic underachievement in university (Mueller & Oppenheimer, 2014).

More importantly, handwriting difficulties may extend beyond academic performance and can affect various aspects of an individual's life. These difficulties often lead to decreased confidence and self-esteem (Montgomery, 2007; Graham & Harris, 2005). Individuals with handwriting difficulties may experience anxiety, stress, or engage in avoidance behaviors when confronted with writing tasks, which can subsequently have a profound impact on their overall language proficiency and social-emotional development (Crouch & Jakubecy, 2007; Ukwueze, 2015). Consequently, the negative consequences of handwriting difficulties highlight the importance of addressing these challenges and providing effective interventions to support students with handwriting difficulties in enhancing their handwriting skills, both for academic success and overall personal wellbeing.

From a psycholinguistic perspective, handwriting engages multiple cognitive processes, including motor skills, visual perception, memory, and attention (Longcamp et al., 2008). Research has consistently highlighted the significance of handwriting in cognitive development. When children, for example, write by hand, they activate extensive brain regions, vital language processing and learning. The sensorimotor integration involved in handwriting facilitates the encoding of information into long-term memory (James, 2019). Handwriting also promotes active engagement with the written material, leading to better conceptual understanding and critical thinking (Salkind, 2008).

Moreover, handwriting is widely considered as a multifaceted perceptual-motor ability that relies on fine motor skills development (Cameron et al., 2012; Maeland, 1992). As students progress through their educational journey, their perceptual-motor abilities are expected to mature, leading to the development of a unique handwriting style characterized by fluency, naturalness, and legibility. The fine motor control required for handwriting supports the formation of letters and words, facilitating the transition from oral to written language (Berninger et al., 2006; Kandel et al., 2020). Furthermore, a number of studies have revealed that children who receive formal handwriting instruction demonstrate better letter recognition and reading fluency (Berninger et al., 2008; Graham et al., 1997). Additionally, handwriting practice helps develop letter knowledge and grapheme-phoneme associations, which are foundational for reading development (Graham, 1992; Graham & Hebert, 2011). This aligns with the observation that when it comes to writing, reading cerebral areas are also activated (James & Engelhardt, 2012).

Overall, handwriting has a vital significance in cognitive and linguistic development. It enhances learning, memory, fine motor skills, and reading proficiency. Handwriting also engages cognitive processes and inspires creative thoughts (Viholainen et al., 2014). The strong link between handwriting and cognitive-linguistic development emphasizes the need for a comprehensive approach to handwriting instruction, ensuring that students, including EFL learners, have the opportunity to develop this essential skill. Addressing handwriting difficulties thus is crucial, as it tends to offer important insights into the multifaceted nature of handwriting difficulties among EFL learners. Such insights can inform the development of effective interventions to support them in achieving academic success and promoting their psychological well-being (Viholainen et al., 2014).

It is worth bearing in mind that students with handwriting difficulties are not necessarily dysgraphic, but rather lack consistent and strict handwriting practice (Jaashan et al., 2023). According to Volman et al. (2006), the prevalence of handwriting difficulties ranges from 5% to 27%. These difficulties can manifest in various ways, including illegible handwriting, slow writing speed, inconsistent letter formation, or challenges with spacing and alignment (Feder & Majnemer, 2007). Additionally, students with handwriting difficulties may exhibit inconsistent use of upper- and lower-case letters, misused punctuation, poor spelling, and an inability to keep letters on the lines (Jaashan et al., 2023). Other common features observed in children with handwriting difficulties include inconsistent letter size, incorrect relative height of letters, letter distortion, ambiguous letter forms, poor word alignment, insufficient word spacing, acute turns in connecting letters, irregularities in joining letters, and an unsteady writing trace (Volman et al., 2006).

Recently, the integration of digital devices within educational settings has been identified as a significant factor contributing to the decline in handwriting skills among EFL learners (Jaashan et al., 2023; Sulzby, 1985). Many recent studies have focused on the negative effects technology have on the development of handwriting skills including decreased practice opportunities, reliance on typing, reduced fine motor skill development, and decreased attention to handwriting instruction (Berninger et al., 2006; Mueller & Oppenheimer, 2014). This, in turn, contributes to the overall decline in handwriting proficiency among EFL learners. More details about the negative impact of technology on handwriting skills will be discussed in the next section, which is devoted to the review of literature.

1.2 Research Problem

There is a growing body of research which suggests that handwriting is critical to the production of creative and organized texts and has an impact not only on fluency but also on the quality of composition (Graham et al, 1997). However, recent studies have found that EFL

learners often encounter many difficulties in exhibiting proficient handwriting skills (Jaashan et al., 2023), which subsequently can negatively affect their language learning development. In this sense, handwriting is an essential skill for EFL learners in order to meet the requirements of second language learning. It develops their ability to take effective notes, communicate clearly in written assignments, and engage in critical thinking. Additionally, handwriting has not only been found to improve memory and understanding (Longcamp et al., 2006), but also to enhance letter recognition and learn new words (Graham & Weintraub, 1996). Developing fluent and legible handwriting can also reduce reliance on technology and promote self-confidence and motivation among EFL learners.

Despite the recognized importance of handwriting for educational progress and the negative effect arising from difficulty with this skill, little attention has been made to investigate the challenges that college-level EFL learners face in developing and maintaining proficient handwriting skills. Besides, the underlying cognitive processes and psycholinguistic factors that contribute to handwriting difficulties among this population have not been sufficiently discussed in the current literature. It would be thus of interest to address this significant research problem by conducting a comprehensive investigation into the multifaceted nature of handwriting difficulties experienced by college-level EFL learners.

1.3 Research Questions

This study seeks to address the following questions:

1. What are the salient manifestations of handwriting difficulties among EFL learners?
2. What are the underlying factors that contribute to handwriting difficulties among EFL learners?
3. What are the most effective interventions for improving handwriting skills among EFL learners?
4. What are the implications of brain research for handwriting instruction?

1.4 Significance of the Study

Handwriting difficulties among students, particularly among boys, have been widely acknowledged in the literature (Volman et al., 2006; Weintraub, 2023). These difficulties can significantly impact their ability to express themselves effectively in written language. Research indicates that interventions focused on handwriting training can lead to improvements not only in the legibility of handwriting but also in overall written composition skills (Jaashan et al., 2023). However, the value of handwriting in language learning and academic success has not been adequately recognized in mainstream education. The emphasis in writing instruction has primarily been on the composing aspects, neglecting a skill that significantly contributes to the quality of compositions. The research suggests that to preserve the skill of handwriting, its importance should be recognized along with reading and writing (Medwell et al., 2009).

This study seeks to contribute to the efforts to recognize the importance of handwriting by exploring handwriting difficulties among EFL learners from both pedagogical and psycholinguistic perspectives. The findings of this study may inspire EFL instructors to regularly incorporate handwriting practice into various academic activities. Furthermore, this study attempts to provide a deeper understanding of the main manifestations of handwriting difficulties among EFL learners. The insights gained can assist educators in developing effective interventions to address these challenges.

Overall, the significance of this study is multifaceted, as it attempts to address the critical role of handwriting in language learning and academic performance of college-level EFL learners. By throwing light on the cognitive, neural, and educational aspects of handwriting, this study is likely to contribute to the improvement of language learning outcomes and the overall academic performance of EFL learners.

2. Review of Literature

2.1 Handwriting Difficulties and Academic Performance

Several studies thus far have linked between handwriting difficulties and student academic performance, especially in areas such as spelling, writing fluency, and overall written expression (Medwell et al., 2007). Graham, et. al. (1997) pointed out that the mechanics of handwriting can impact the quality and quantity of composing. Similarly, Crouch and Jakubecy (2007) and Ukwueze (2015) emphasized the negative impact of illegible handwriting on the assessment of students' performance. When students struggle with handwriting, their written output may be difficult to read, leading to misunderstandings in the evaluation and grading process. Teachers may have difficulty accurately deciphering the content of the students' work, which can impact their assessment of the students' knowledge and skills (Richards, 1999). Therefore, the skill of handwriting is generally recognized as an important gateway to academic progress (Graham, 1992; Jaashan et al., 2023).

Recently, there has been an increase of interest in the prevalence of handwriting difficulties among EFL learners. For example, a study by Oche (2014) found that a significant proportion of EFL students exhibited poor handwriting, which negatively affected their educational progress. In another major study, Jaashan et al. (2023) examined the impact of handwriting difficulties on academic performance in a sample of 64 EFL college students (male and female) and found that those with poor handwriting scored lower marks, whereas those with good handwriting achieved higher marks in exams.

Feder and Majnemer (2007) proposed that poor handwriting can lead to increased cognitive load during writing tasks. This suggests that students with handwriting difficulties may need to allocate more mental resources to concentrate on forming letters accurately, resulting in reduced cognitive capacity available for higher-order writing processes, such as organizing ideas and expressing thoughts coherently. This

increased cognitive load can impede students' ability to effectively express their ideas in written forms, which could negatively affect their performance in exams.

A plethora of studies have shown a positive connection between handwriting and cognitive processes. For example, it has now been revealed that handwriting promotes better memory retention, idea generation, and overall language skills (Berninger et al., 2019; James & Engelhardt, 2012). Also, brain research shows that handwriting engages multiple sensory and motor systems, promoting better retention, comprehension of information, and information recall (Longcamp et al., 2005). In addition, handwriting allows students to record their ideas and emotions through a personal and tangible medium. It fosters self-expression, individuality, and a sense of ownership over one's work (Puranik & Al Otaiba, 2012). Strong handwriting skills, therefore, positively effect academic performance, facilitate better communication, and contribute to the overall success of students.

Taking together, these studies highlight the importance of addressing handwriting challenges among EFL learners to support their academic progress and written communication skills. The current literature provides a strong foundation for further exploring the specific factors contributing to these difficulties and developing targeted interventions to support EFL students' handwriting development. The main purpose of this study, therefore, is to contribute to this growing area of research through enhancing awareness of handwriting difficulties among undergraduates with handwriting difficulties.

2.2 Digital Technology and Handwriting Difficulties

As was pointed out in the introduction to this study, the integration of digital technology into language learning has raised concerns about its potential adverse effects for traditional skills, particularly handwriting. Excessive use of digital media, such as smartphones and tablets, has been linked to a decline in various aspects of well-being at home and at school (Rosen et al., 2014). The constant interaction with touchscreens and reliance on auto-correction features may contribute to decreased legibility and inconsistency in letter formation. Furthermore, the lack of sensory feedback and tactile experiences associated with traditional pen-and-paper writing can hinder the development of fine motor skills necessary for proficient handwriting (Rosemary, 2006).

However, some researchers suggest that the integration of technology can positively affect the development of handwriting abilities. Digital tools and applications specifically designed to support and enhance handwriting skills can provide interactive exercises, real-time feedback, and guidance, improving fine motor control and letter formation. A study by Chang and Yu (2014) suggested that technology-assisted interventions can efficiently improve several features of handwriting and overall writing proficiency, particularly among children with handwriting difficulties. These technology-based approaches can offer engaging and interactive activities that foster the development of handwriting skills.

2.3 The Neural Underpinnings of Handwriting

Handwriting is considered as one of the major components of language production that relies on the interaction of multiple cognitive processes and motor functions (Planton et al., 2013). Recent brain imaging studies have revealed important insights into handwriting cognitive processes and their neural underpinnings. A growing body of evidence suggests that both sensory and motor brain areas are activated during handwriting, including the "reading network" responsible for efficient letter and word processing (James & Berninger, 2019). This network includes the left fusiform gyrus, the inferior frontal gyrus, and the left superior temporal gyrus/inferior parietal lobule (Dehaene, 2009, as cited in James & Berninger, 2019). Moreover, these regions, together with the left dorsal precentral gyrus and left middle frontal gyrus, are activated during the perception and processing of individual letters. These areas are crucial for writing execution and direct motor control (James, 2017). The same brain network is active when adults write letters by hand (James & Gauthier, 2006; as cited in James & Berninger, 2019). The activation of these regions during handwriting tasks highlights the complex cognitive and physical processes involved in handwriting, highlighting its vital role in the development of various skills and abilities (see Figure 1).

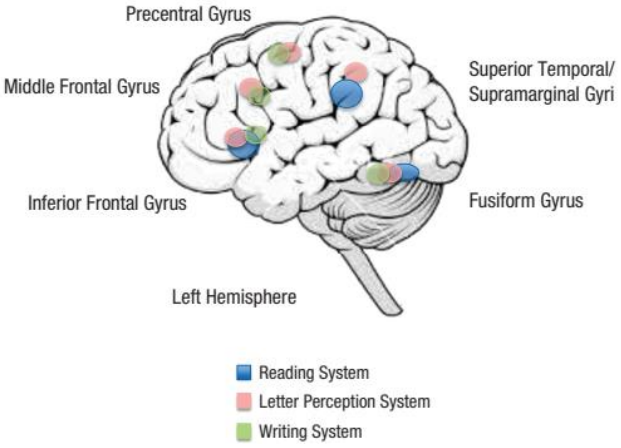

Figure 1. A representation of the brain areas that are active during reading, writing and letter perception tasks in the left hemisphere. (From James, 2017)

3. Methodology

3.1 Study Design

This study is a descriptive-analytical research in which a mixed-methods approach was employed. The data obtained was analyzed statistically, representing the quantitative component. The qualitative aspect was incorporated by collecting and analyzing the participants' handwriting errors and noticeable manifestations of handwriting difficulties. This mixed-methods design allowed for a comprehensive examination of the handwriting challenges faced by EFL learners, incorporating both quantitative analysis of the data and qualitative insights into the specific manifestations of the observed handwriting difficulties.

3.2 Participants

A total of eighty EFL learners with handwriting difficulties at universities participated in this study. They were initially recruited by their teachers based on their performance in various quizzes and exercises related to spelling and writing skills. The researcher then reviewed the participants' notebooks and test papers to verify the legibility and readability of their handwriting. In essence, the study include a purposive sample of EFL learners, who were selected from the Department of English Language and Literature, College of Science and Humanities, Prince Sattam bin Abdulaziz University, and the Department of English Language, Faculty of Arts, Taiz University based on the specific criteria of exhibiting handwriting difficulties. The sample size was determined based on the principle of data saturation, ensuring an adequate representation of the observed handwriting difficulties.

Table 1. Participants

Gender	Percentage	Age range	L1	Period of learning English
30 Females	37.5%	18-22	Arabic	6 years and above
50 Males	62.5%	18-22	Arabic	6 years and above

As Table 1 shows, among 80 EFL learners involved in this study, 50 were males and 30 were females. They all were enrolled in a B.A. program in English with an age range of 18 to 22 years. They had been learning English for over 6 years, and their native language was Arabic. Prior to commencing the study, the participants were verbally consented. They were assured that the collected data would be used exclusively for research purposes, and no form of coercion would be applied to those unwilling to participate.

3.3 Instruments

A text titled *Hepatitis* was administered to all the participants. The researcher selected the text considering its suitability to the participants' English proficiency level. The handwriting task involved the replication of a standard text provided on a printed paper within a time of 5 minutes. For slower writer, they were instructed to complete at least the first four lines. The purpose of choosing the same text for everyone was to collect samples of their handwriting on a specific text designed for writing English letters and words.

The participants were requested to write in their usual handwriting style on an A4 sheet of paper. Handwriting difficulties were assessed based on 9 criteria, which were adopted from existing literature (Jaashan et al., 2023; Volman et al., 2006). These criteria included: 1) letter size consistency, 2) legibility, 3) word spacing, 4) letter spacing, 5) letter shape, 6) word alignment, 7) left margin, 8) handwriting speed 9) letter height. The participants' handwriting quality was evaluated on a three-point scale: highly satisfactory, satisfactory, and unsatisfactory, indicating the degree of deviation from the norm.

3.4 Data Collection and Analysis

The participants' history of handwriting was first obtained through interviews with their teachers. Their notebooks were also checked by the researcher to ensure they met the study's criteria and were appropriate for the given goal. Then, a short text was given to them to rewrite it within a limited time of five minutes. The handwriting samples were collected and analyzed using simple descriptive statistical analysis, processed through SPSS version 0.26 (2019). Qualitative data, such as transcripts and field notes were also coded and categorized to identify common patterns related to the observed handwriting difficulties.

3.5 Study Limitations

This study involved a limited sample size of 80 EFL students from two universities. If the study had included a larger participant pool across multiple universities, the findings could have potentially yielded greater validity and reliability.

4. Results

The descriptive statistics provide insights into the performance of the participants on the handwriting task assigned using frequencies and percentages to analyze the quantitative data and evaluate the manifestations of handwriting difficulties exhibited by EFL learners based on the criteria outlined in Section 3.

Letter Size Consistency

Table 2 illustrates a descriptive statistics analysis of the subjects' scores in writing letters with appropriate sizes. Three grading categories of the participants' performance are provided: highly satisfactory, satisfactory and unsatisfactory.

Table 2. Letter Size Consistency

Categories	Frequency	Percentage
Highly Satisfactory	8	10
Satisfactory	26	32.5
Unsatisfactory	46	57.5
Total	80	100

As Table (2) shows, out of the total 80 participants, 46 (57.5%) experienced difficulty in writing letters at appropriate sizes, while 26 (32.5%) and 8 (10%) demonstrated satisfactory and highly satisfactory performance in this aspect respectively. These results do align with previous studies conducted by Volman et al. (2006) and Jaashan et al. (2023), which have identified challenges faced by individuals with handwriting difficulties, including the inability to maintain consistent letter size. The alignment between the current study's results and the results of the existing literature supports the finding that letter size inconsistency is one of the noticeable manifestations of handwriting difficulties among individuals with handwriting difficulties.

Handwriting Legibility

Table 3 illustrates the findings obtained from the analysis of the participants' handwriting legibility.

Table 3. Handwriting Legibility

Categories	Frequency	Percentage
Highly Satisfactory	6	7.5
Satisfactory	12	15
Unsatisfactory	62	77.5
Total	80	100

It can be seen from the data in Table 3 that the handwriting legibility of 62 participants (77.5%) was unsatisfactory. In contrast, 12 participants (15%) demonstrated satisfactory legibility, while only 6 participants (7.5%) reached a highly satisfactory level. These findings are consistent with those of Graham (1990) and Weintraub (2023), who found illegibility as a prevalent characteristic of EFL learners experiencing handwriting difficulties. It is therefore plausible to suggest that poor handwriting legibility is a significant challenge faced by EFL learners with handwriting difficulties examined in the current study.

Word Spacing

Table 4 presents the findings obtained from the analysis of the participants' performance in maintaining sufficient word spacing.

Table 4. Word Spacing

Categories	Frequency	Percentage
Satisfactory	26	32.5
Unsatisfactory	54	67.5
Total	80	100

It is apparent from the data in Table 4 that 54 participants (67.5%) experienced significant difficulty in maintaining sufficient word spacing. In contrast, 26 of the participants (32.5%) demonstrated satisfactory performance in terms of word spacing. It is therefore plausible to conclude that the participants examined in this study faced significant challenges in maintaining appropriate word spacing. These findings align with previous studies conducted by Feder and Majnemer (2007), Volman et al. (2006), and Graham et al. (2006), which also found that individuals with handwriting difficulties can exhibit various manifestations, including difficulties with word spacing. This highlights the importance of addressing word spacing as a crucial aspect of handwriting difficulties.

Letter Spacing

Table 5 presents the findings obtained from the analysis of the participants' performance in maintaining sufficient letter spacing.

Table 5. Letter Spacing

Categories	Frequency	Percentage
Highly Satisfactory	8	10
Satisfactory	30	37.5
Unsatisfactory	42	52.5
Total	80	100

Table 5 illustrates that 42 participants (52.5%) experienced difficulty in determining sufficient letter spacing when writing words. Thirty participants (37.5%), on the other hand, achieved satisfactory results in determining letter spacing, while 8 participants (10%) highly satisfactorily demonstrated this skill. These findings further support the findings reached by Jaashan et al. (2023), which indicated that EFL learners with handwriting difficulties struggle to determine adequate letter spacing. The alignment between the current study's results and the results of the previous study by Jaashan et al. (2023) further supports the notion that inadequate letter spacing is a prominent manifestation observed among EFL learners with handwriting difficulties.

Letter Shape

Table 6 presents the findings obtained from the analysis of the participants' performance in producing letters with appropriate shapes.

Table 6. Letter Shape

Categories	Frequency	Percentage
Highly Satisfactory	4	5
Satisfactory	30	37.5
Unsatisfactory	46	57.5
Total	80	100

The data presented in Table 6 show that 46 participants (57.5%) had unsatisfactory letter shape. On the other hand, 30 participants (37.5%) achieved satisfactory letter shape, and only 4 participants (5%) demonstrated highly satisfactory letter shape. These results suggest that a majority of the participants examined in this study faced difficulty in producing letters with appropriate shapes. These results are consistent with those of Jaashan et al. (2023), which suggest that inconsistent letter shape is a common feature faced by EFL learners with handwriting difficulties. This consistency demonstrates poor letter spacing as a significant challenge experienced by individuals with handwriting difficulties.

Left Margin

Table 7 presents the findings obtained from the analysis of the participants performance in maintaining appropriate left margin.

Table 7. Left Margin

Categories	Frequency	Percentage
Highly Satisfactory	6	7.5
Satisfactory	24	30.0
Unsatisfactory	50	62.5
Total	80	100

The data in Table 7 show that 50 participants (62.5%) demonstrated unsatisfactory left margin when performing the assigned task, while 24 participants (30%) achieved satisfactory left margin, and only 6 participants (7.5%) achieved highly satisfactory left margin. These results clearly indicate that maintaining proper left margin is a challenge faced by the majority of EFL learners examined in the current study. It is interesting to note that these findings differ from the results reported by Volman et al. (2006) regarding left margin in children with handwriting difficulties. This discrepancy may be attributed to variations in age and sample characteristics between the current study, which focused on college students, and the study conducted by Volman et al. (2006), which examined school-aged children.

Handwriting Speed

Table 8 presents the findings obtained from the analysis of the participants' handwriting speed.

Table 8. Handwriting Speed

Categories	Frequency	Percentage
Highly Satisfactory	10	12.5
Satisfactory	12	15.0
Unsatisfactory	58	72.5
Total	80	100

As Table 8 illustrates, 58 participants (72.5%) exhibited unsatisfactory writing speed. In contrast, 12 participants (15%) demonstrated satisfactory writing speed, while 10 participants (12.5%) achieved highly satisfactory writing speed. These results indicate that a majority of EFL learners examined in this study can be classified as slow writers. These results are in consistent with those of Volman et al. (2006) and Weintraub (2023), who also reported that individuals with handwriting difficulties are slow writers. The consistency between the findings of this study and the previous ones supports the notion that slow writing is a common characteristic associated with individuals experiencing handwriting difficulties.

Letter Height

Table 9 presents the findings obtained from the analysis of the participants' performance in maintaining appropriate letter height.

Table 9. Letter Height

Categories	Frequency	Percentage
Highly Satisfactory	14	17.5
Satisfactory	36	45
Unsatisfactory	30	37.5
Total	80	100

It is observed from Table 9 that 36 participants (45%) exhibited satisfactory letter height. However, 30 participants (37.5%) demonstrated unsatisfactory letter height, while 14 participants (17.5%) achieved highly satisfactory results. These results indicate that although a majority of the EFL learners examined in this study write with the correct relative height of letters, there is still a significant portion that struggles to maintain appropriate letter height. These results are inconsistent with the conclusions drawn by Volman et al. (2006), who reported that children with handwriting problems tend to exhibit unsatisfactory control in maintaining appropriate letter height in their handwriting. This inconsistency may be resulted from variations in the specific challenges faced by individuals with handwriting difficulties across different studies or populations.

Word Alignment

Table 10 presents the findings obtained from the analysis of the participants' performance in maintaining proper word alignment.

Table 10. Word Alignment

Categories	Frequency	Percentage
Highly Satisfactory	20	25
Satisfactory	24	30
Unsatisfactory	36	45
Total	80	100

The data presented in Table 10 show that 36 participants (45%) experienced poor word alignment when performing the task, 24 participants (30%), on the other hand, achieved satisfactory word alignment, while 20 participants (25%) demonstrated highly satisfactory alignment of words. Based on the results, word alignment poses a challenge for a majority of EFL learners examined in this study. These results align with those of Feder and Majnemer (2007) and Volman et al. (2006), which also suggested that individuals with handwriting difficulties struggle with word alignment. It is therefore important to address word alignment as a common challenge faced by individuals with handwriting difficulties.

Table 11 provides a summary of the descriptive statistics of the key manifestations of handwriting difficulties experienced by EFL learners examined in this study. It shows the participants' mean scores ranging from 2.20 to 2.68, with standard deviations between 0.471 and 0.833.

Table 11. Means and Standard Deviations of Handwriting Difficulties Manifestations

Manifestation	Mean	Std. Deviation
Letter Size Consistency	2.48	0.675
Legibility	2.71	0.578
Word Spacing	2.68	0.471
Letter Spacing	2.49	0.656
Letter Shape	2.54	0.594
Left Margin	2.56	0.633
Speed	2.61	0.703
Letter Height	2.21	0.724
Alignment of Words	2.20	0.833
X	2.6847	0.12305)

Note: Based on the Likert scale used for evaluating the participants' performance in handwriting difficulties, a mean score of 1-1.66 indicates a highly satisfactory performance, 1.67-2.33 indicates a satisfactory performance, and 2.34-3 indicates an unsatisfactory performance.

As shown in Table 11, the participants' scores in the evaluated handwriting manifestations are as follows: Letter Size Consistency (M = 2.48), legibility (M = 2.71), word spacing (M = 2.68), letter spacing (M = 2.49), letter shape (M = 2.54), left margin (M= 2.56), handwriting speed (M = 2.61). These scores fall within the range of 2.34-3, indicating that the participants unsatisfactorily exhibited these seven handwriting manifestations. Therefore, it can be suggested that inconsistent letter size, illegibility, poor word spacing, poor letter spacing, ambiguous letter shape, excessive left margin, and poor handwriting speed are key manifestations of handwriting difficulties observed in the participants examined in this study. On the other hand, the participants scored between 1.67-2.33 in letter height (M = 2.21) and alignment of words (M = 2.20). Accordingly, letter height and alignment of words cannot be considered prominent manifestations of handwriting difficulties in the participants examined in this study.

In summary, the evaluation of the participants' handwriting difficulties revealed that the participants performed unsatisfactorily in all features, except for the features "letter height" and "alignment of words" which were satisfactorily demonstrated. These findings provide insights into the challenges faced by the participants and highlight the importance of addressing and supporting the development of handwriting skills related to letter size consistency, legibility, letter/word spacing, letter shape, margin, and handwriting speed.

5. Discussion and Conclusions

The main purpose of this study is to investigate handwriting difficulties among EFL learners. It specifically aims to provide data that help to answer the following key questions: 1. What are the salient manifestation of handwriting difficulties among EFL learners? 2. What are the underlying factors that contribute to handwriting difficulties among EFL learners? 3. What are the most effective interventions for improving handwriting skills among EFL learners? 4. What are the implications of brain research for handwriting instruction? These questions will be discussed on the basis of the results obtained and the findings of previous studies.

5.1 Manifestations of Handwriting Difficulties

The findings of this study reveal several significant manifestations of handwriting difficulties among the EFL learners examined in this study. The participants consistently exhibited suboptimal performance in key handwriting features such as letter size consistency, legibility, word spacing, letter spacing, letter shape, left margin, and writing speed.

Regarding letter size consistency, participants often wrote with letter sizes that deviated from the expected standard, with some using

larger and others using smaller letter sizes. This lack of control and consistency in maintaining appropriate proportions may be linked to challenges in spatial awareness, visual-motor coordination, fine motor skills, or spatial perception. Addressing these underlying issues is crucial for helping EFL learners develop more legible and aesthetically pleasing handwriting.

Similarly, the participants struggled with providing adequate spacing between words and letters, often leaving no space at all. This can negatively impact the readability and comprehensibility of the written text, making it difficult for readers to distinguish between words and follow the progression of ideas. Improving word and letter spacing is an important focus for interventions aimed at enhancing the overall quality of the participants' written work.

The inconsistent or inadequate left margin observed in the participants' writing can also compromise the visual organization and readability of the text. A lack of consistent left margin can make it challenging for readers to track the progression of lines and comprehend the structure of the written work. It can also affect the overall aesthetics and presentation of written work. Addressing these left margin difficulties is crucial for improving the overall presentation and legibility of the participants' written communication.

Additionally, the participants tended to write at a slower pace compared to the expected writing speed. This slowness in handwriting can have significant implications for the participants' academic performance, as it can affect their note-taking effectiveness and working memory capacity. Interventions targeting the improvement of writing speed and fluency may lead to enhanced overall writing performance and written communication skills.

Another manifestation of handwriting difficulties observed was the inconsistent letter shapes, with variations in the size, proportions, and angles of individual letters, as well as instances of distorted or misshapen letters. These challenges can compromise the legibility and aesthetic quality of the participants' handwriting, further emphasizing the need for targeted interventions to address letter shape consistency.

The legibility of the participants' handwriting was also assessed, and it was found that they faced challenges in maintaining consistent letter sizes, adequate spacing, consistent alignment, and overall penmanship. These legibility issues can negatively impact the participants' ability to effectively communicate in writing and may hinder their language development and academic performance.

The identified manifestations of handwriting difficulties among the EFL learners in this study align with previous research conducted in this area (e.g., Jaashan et al., 2023; Ziviani and Elkins, 1984; Weintraub, 2023), suggesting that these challenges are not unique to this population. However, it is essential to note that the specific manifestations may be influenced by factors such as individual motor skills, cognitive abilities, cultural background, and writing habits. Therefore, interventions should be tailored to the unique needs and characteristics of each learner.

5.2 Underlying Factors of Handwriting Difficulties

Cognitive research on handwriting has documented several underlying processes and factors that seem to contribute to the handwriting difficulties observed in this study. Difficulties with visual-motor integration- the ability to coordinate visual information with a motor response- tend to be an important factor that might affect handwriting ability resulting in irregularities in letter size and shape (Shen et al., 2012). In addition to influencing letter spacing, alignment, and page organization, poor spatial awareness has also been documented to have an effect on handwriting, leading to messy or inconsistent handwriting (Olive & Passerault, 2012).

Letter formation and maintaining proper letter spacing can be hindered by deficiencies in fine motor control and the ability to execute precise movements (Dinehart, 2014). Handwriting can also be affected by problems with sensorimotor integration, or the ability to process and combine sensory information with motor actions. Maintaining appropriate pressure, spacing, and letter formation might be difficult if one has difficulties in receiving and interpreting sensory input such as touch, proprioception, and pressure (Rosenblum et al., 2013). Decreased proprioceptive-kinesthetic finger awareness may cause increased fatigue limiting the automaticity and level of handwriting performance (Schneck, 1991).

Cognitive processes required for language production as well as planning, executing, and monitoring handwriting can simultaneously affect the speed and fluency of handwriting (Berninger & Winn, 2006; Peverly, 2013). Additionally, deficits in cognitive processes, including working memory, attention, and executive function, may contribute to disorganized writing by impairing the ability to organize thoughts, sustain attention, and coordinate multiple cognitive demands when writing (Purvis & Tannock, 1997). Studies conducted by Wang et al. (2021) and Swanson and Berninger (1996) have found that working memory problems can affect handwriting, as students may have difficulty remembering letter forms, maintaining appropriate spacing, or smoothly shifting between letters and words.

Perceptual-motor coordination, which includes hand-eye movements as well as the tempo and flow of handwriting, has also been identified as a factor affecting handwriting quality, with difficulties resulting in messy, illegible or labored writing (Exner,1989). Finally, a lack of automaticity in the writing process can contribute to slowness and inconsistency in the production of letters (Bara & Morin, 2013; Santangelo & Graham, 2016). These underlying mechanisms interact in complex ways, highlighting the importance of understanding them in order to design effective interventions for the handwriting difficulties encountered by struggling EFL learners.

5.3 Handwriting Interventions

Interventions designed to address handwriting difficulties faced by EFL learners have been recognized essential in helping them enhance their written communication skills. These interventions include strategies, programs, and approaches that aim to address certain

handwriting difficulties, such as letter formation, spacing, legibility, and consistency. Effective interventions can provide obvious improvements in handwriting skill for EFL learners, leading to increased confidence, better written expression, and overall academic achievement.

One of the proposed interventions is a multisensory training program. This instructional approach combines auditory, visual, and tactile elements to enhance letter formation and motor memory while encouraging handwriting practice across several senses. Using tools like textured surfaces or sensory writing materials, this program seeks to improve motor skills, reinforce letter formation, and improve handwriting skills. Current research has revealed the effectiveness of this multisensory approach in improving handwriting skills in children with handwriting difficulties (Jegadeesan & Nagalakshmi, 2018).

Another effective intervention is a supplementary handwriting instruction, the effective of which has been demonstrated by various previous studies like Feder and Majnemer (2007) and Graham (1992). This approach provided explicit instruction, guided practice, and corrective feedback. It specifically leads to enhance letter formation, improve spacing between letters and words, and increase legibility of students' written work. The effectiveness of this program was reported by Feder and Majnemer (2007), who concluded that a supplementary handwriting instruction can effectively address handwriting difficulties and improve accuracy and fluency of handwriting performance among students who encounter difficulty mastering this skill.

Additionally, peer collaboration and feedback are crucial components in addressing handwriting difficulties among EFL college students. Engaging in collaborative activities fosters self-reflection, constructive critique, and the sharing of diverse strategies and perspectives. This supportive social environment allows students to discover new techniques and refine their handwriting skills. Positive feedback and motivation from peers can further enhance students' confidence and commitment to improve accuracy and fluency of handwriting performance.

Finally, integrating technology can significantly contribute to addressing handwriting difficulties among EFL learners (Kandel et al, 2020). Digital devices and resources, such as handwriting apps and software, offer interactive platforms for practicing letter formation, spacing, and handwriting fluency. Real-time feedback, customizable exercises, and engaging features help students refine their skills in a more interactive manner. Furthermore, digital writing tablets and smart pens can capture and analyze students' handwriting, providing immediate feedback and corrective measures.

By incorporating a range of targeted interventions, including multisensory programs, supplementary handwriting instruction, peer collaboration, and the strategic use of technology, educators can effectively improve the handwriting skills of EFL learners. These comprehensive approaches leverage the cognitive and neural advantages associated with handwriting, promoting the development of language, motor, and cognitive skills essential for learning.

5.4 Implications of Brain Research for Handwriting Instruction

Recent findings in neuroscience have revealed the intricate neural networks involved in handwriting, with significant implications for educational practice. Neuroimaging studies have confirmed the involvement of an extensive network of brain regions in fine motor control, language processing, and higher-order cognition (James & Engelhardt, 2012; Peña et al., 2018). Recent evidence suggests that writing by hand results in more activation in the sensorimotor cortex, premotor cortex, and cerebellum (Longcamp et al., 2006). Moreover, the process of forming letters by hand results in the formation of extensive neural connectivity patterns essential for facilitating learning (Van der Weel & Van der Meer, 2024). These findings highlight the utmost importance of handwriting in educational settings.

Moreover, teaching handwriting has been found to have positive effects on letter recognition, word reading, and text composition skills (Berninger et al., 2006; James & Berninger, 2019; Longcamp et al., 2005). The neural encoding of letter shapes and their correlations with sound-based representations appear to be facilitated by the kinesthetic feedback and visuospatial processing involved in handwriting (James, 2017; Velay & Longcamp, 2013). Furthermore, studies have shown handwriting affects written texts' overall quality and composition in addition to writing fluency (Bounds, 2010; Berninger & Winn, 2006; Graham et al., 1997).

Importantly, difficulties in handwriting fluency have been linked to more general academic challenges, including poorer reading comprehension and text composition skills (Bara & Morin, 2013; Graham et al., 1997). For example, Medwell et al. (2007) found that children with handwriting difficulties dedicate more brain capacity to getting words onto a page, which often affects planning and content generation. This demonstrates the cumulative cognitive benefits of handwriting proficiency and the necessity of giving it top priority in literacy instruction.

Given the neural and cognitive benefits of handwriting, researchers have stressed the importance of including at least a minimum of handwriting instruction into educational curricula (Berninger & Winn, 2006; Peverly, 2006; Van der Weel & Van der Meer, 2024) and the need for implementing multimodal, sensorimotor approaches to handwriting instruction, such as tracing, copying, and writing exercises (Berninger et al., 1997; Dinehart, 2014). Explicit instruction in proper letter formation and fluency-building exercises have also been recommended to take advantage of the neural and cognitive benefits of handwriting (Santangelo & Graham, 2016). Maintaining a balance between conventional handwriting instruction and digital literacy can boost the development of motor and cognitive skills vital for learning and academic success.

5.5 Conclusions

The decreasing handwriting proficiency of EFL learners has become a pressing concern in the current digital era. Given the continuing

substitution of handwriting by typing and the decline of traditional handwriting practices, it is crucial to stress the need of preserving proficient handwriting skills. Beyond being an important means of written communication, handwriting also supports the development of fine motor abilities and cognitive processes. It forces learners to think critically, organize their ideas, and express their thoughts. Furthermore, handwriting is a critical lifelong skill that goes beyond academic studies and acts as a distinctive means of personal identification. However, the emergent of digital devices and the shift towards digital typing as the primary mode of written communication has led to a concerning "handwritingcide" – the detrimental decline of handwriting proficiency due to the increased reliance on digital typing in almost every educational setting. To address this critical issue, strategies such as integrating explicit handwriting instruction, balancing digital and traditional writing tasks, and utilizing digital devices that enhance handwriting proficiency can be used (Mackenzie et al., 2012). Additionally, creating a well-balanced learning environment that promotes peer collaboration, constructive feedback, and positive reinforcement can inspire students to overcome their handwriting difficulties and develop efficient handwriting skills. Through these concerted efforts, EFL learners can preserve the significance of handwriting and retain the pedagogical and cognitive advantages related with learning this unique human skill. It is to be mentioned here that our emphasis on handwriting is not rejection for the use of technological devices in literacy. Rather, we see that maintaining handwriting proficiency is crucial, as it not only serves as an essential mode of communication but also contributes to the holistic development of students' academic and professional competencies.

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Appendix

Samples of the Participants' Handwritings