



THE ROLE OF HANDWRITING INSTRUCTION IN WRITERS' EDUCATION

Teresa Limpo & Steve Graham

To cite this article: Teresa Limpo & Steve Graham (2020) THE ROLE OF HANDWRITING INSTRUCTION IN WRITERS' EDUCATION, British Journal of Educational Studies, 68:3, 311-329, DOI: [10.1080/00071005.2019.1692127](https://doi.org/10.1080/00071005.2019.1692127)

To link to this article: <https://doi.org/10.1080/00071005.2019.1692127>



Published online: 14 Nov 2019.



Submit your article to this journal [↗](#)



Article views: 248



View related articles [↗](#)




View Crossmark data [↗](#)



Citing articles: 2 View citing articles [↗](#)



THE ROLE OF HANDWRITING INSTRUCTION IN WRITERS' EDUCATION

by TERESA LIMPO , Faculty of Psychology and Education Sciences of the University of Porto and STEVE GRAHAM, Mary Lou Fulton Teachers College, Arizona State University

ABSTRACT: Based on the Writer(s)-within-Community Model, this article focuses on the role of handwriting in writers' composing process. With the goal of highlighting the importance of researching and promoting handwriting, we provide an extensive summary of current evidence on the topic. It is well established that an important condition for skilled writing is handwriting automaticity. As here reviewed, there are at least four reasons why poor and slow handwriting can interfere with writing: it has a negative impact on the reader, creates a mismatch between ideas generation and recording, imposes heavy demands on working memory, and turns writing into a painful experience. Grounded on this, we make the case for providing child and adolescent writers with explicit and systematic practice in handwriting through evidence-based practices. The best practices at the letter (e.g., alphabet exercises), word/sentence (e.g., copying exercises), and text (e.g., authentic writing tasks) levels are reviewed. We conclude that the integration of handwriting practices into the educational program of beginning and developing writers is particularly important. It may allow the creation of solid basis for other writing abilities to flourish and therefore contribute to the emergence of capable and motivated writers.

Keywords: handwriting fluency, handwriting legibility, instruction, evidence-based practices

1. INTRODUCTION

The scientific study of writing enjoys a rich and lengthy history, with handwriting playing a central role in these pursuits (e.g., Thorndike, 1910). Over the ensuing decades, scholars employed a variety of lenses to study and theorize about writing, including behavioural (Porter, 1962), cognitive (Hayes and Flower, 1980), linguistic (De Beaugrande, 1978), social (Russel, 1997), historical (Bazerman, 2016), and expressivist approaches (Elbow, 1998). In the last 40 years, writing has been dominated by two basic viewpoints: cognitive and social. Handwriting has been a central component in many cognitive models, as exemplified by the Not-So-Simple Model of Writing (Berninger and Amtmann, 2003), where transcription skills like handwriting

This article has been republished with minor changes. These changes do not impact the academic content of the article.

along with text generation and executive functioning are used to describe key components of the composing process. While handwriting is not frequently the subject of social models of writing (e.g., Russell, 1997), writing and by extension handwriting is a tool that writers use in social situations to accomplish one or more desired goals, as when writers make handwritten notes in a physics class to help them identify and remember important points.

The skill of handwriting is a building block of writing. Still, considered by many researchers and educators as solely a motor and mechanical act, its role in writing is easily belittled. As a consequence, there is still little research into handwriting, and this skill is sometimes neglected in the classroom. In this article, we intend to highlight the importance of researching and promoting handwriting. For that, we provide a review of current evidence not only supporting the inclusion of handwriting into writer's education curricula but also on the best practices to promote it effectively. In what follows, we describe a recent writing model articulating cognitive and social viewpoints, define handwriting and explain how it can influence the acquisition and development of writing, provide hints to assess handwriting with examples supporting the need to teach it beyond primary grades, and present several practices to promote handwriting in child and adolescent writers.

2. THE WRITER(S)-WITHIN-COMMUNITY MODEL

The Writer(s)-within-Community Model of writing (WWC; Graham, 2018a, 2018b) combines cognitive and social perspectives of writing to provide a more complete and nuanced perspective on writing and the role of handwriting in the composing process. This integrative approach integrates and expands the cognitive writing models that typically ignore the sociocultural dimension of writing (e.g., Hayes, 2012), and the sociocultural writing perspectives that generally neglect writers' cognitive and motivational resources (e.g., Bazerman, 2016). The WWC model therefore proposes that writing (and by extension handwriting) is simultaneously shaped and constrained by context, the capabilities and perceptions of writers and collaborators operating in said context, and the interaction between the two.

Grounded on the position that writing is a socialized activity (Hull and Schultz, 2001), the WWC model is based on the assumption that writing is a social activity situated within specific communities. A writing community involves a group of people who share a basic set of goals and assumptions and use writing (and in some instances handwriting) to achieve their purposes (Graham, 2018a). People who write or are learning to write are likely to be a member of multiple writing communities (i.e., English class at school, on-line discussion group), with different levels of understanding, commitment, and engagement in specific communities. Stemming from activity theory (Greeno and Engeström, 2014) and genre concepts (Bazerman, 1994), the author proposes a conceptualization of writing communities with the following basic components: the different *purposes* for which writing is used, which involves goals, values, norms, stance/identity, audiences, motivations

(Shanahan *et al.*, 2011); the *members* who compose (writers and collaborators) and help to compose (teachers and mentors), along with the readers (Cameron *et al.*, 1996); the *tools* used to write, such as paper and pencil, word processors, speech-to-text-synthesizers (Gabrial, 2008); the *actions* employed to achieve writing goals in the community (Russel, 1997); the *written products* produced, such as text, text produced so far, plans, notes, drawings (Moje, 2009); the *physical and social environments* where writing communities are situated (Hsiang and Graham, 2015), the *collective history* that shape the writing community over time (Schultz and Fecho, 2000), and the *macro-level forces* (*viz.*, social, cultural, political, institutional, and historical) that influence writing communities and their collective history (Graham, 2018a, 2018b). Together, these components shape writing and the role of handwriting in composing.

In some writing communities handwriting may be highly privileged, such as classrooms in schools where digital composing tools are not readily available (Santangelo and Graham, 2016). In other communities, handwriting may be non-existent, as is the case with Twitter where users post and interact via digital messages. Some writing communities may emphasize legibility, like an English teacher who stresses that papers written for class must be easy to read and pleasing to the eye, whereas a different class may emphasize fluency as writing by hand is mostly used to record personal notes. Still other writing communities may promote a particular handwriting identity, such as a writing group who use calligraphy to write. As these examples illustrate, the role of handwriting varies across writing communities, taking on different purposes and identities.

The WWC model is also based on the assumption that writing in a community is accomplished by its members, who draw on the same basic cognitive architecture when writing. This cognitive architecture includes: *long-term memory* resources holding different types of knowledge (Olinghouse *et al.*, 2014) and various sets of beliefs (Hidi and Boscolo, 2007); *control mechanisms* that are applied to direct, maintain, and switch attention, as well as to regulate and monitor multiple aspects of writing (Diamond, 2013), and *production processes*, which include the mental and physical operations writers apply to produce text (Berninger and Winn, 2006; Hayes, 2012; Kellogg, 1996), namely, conceptualization (construction of a mental representation of the writing task), ideation (generation of ideas from memory and/or external sources), translation (transformation of pertinent ideas into acceptable sentences), transcription (conversion of ideas into sentences either on paper or digitally, which among other processes involves handwriting), and reconceptualization (engagement in the act of revision). Writers' access to long-term memory resources and their use of control and production processes is moderated by a set of *modulators*, such as emotions, personality traits, and physical state of writers and their collaborators (e.g., Boekaerts, 2011). It is assumed that writers and collaborators possess agency, and this agency is a driving force behind what is written (and how and if handwriting is applied).

Given the complex interaction between writing community and the cognitive capabilities of its members, the WWC model further presumes that writing is a cognitively demanding task, constrained by limitations in processing. For beginning and developing writers, as well as for children with learning disabilities such as those with developmental coordination disorder (Prunty *et al.*, 2013), the act of putting words onto paper imposes heavy demands on the limited capacity of working memory, thereby depleting available attentional resources and preventing the activation of other processes (Bourdin and Fayol, 1994; Kellogg, 1996; McCutchen, 1996). For example, when young children have to pay so much attention to writing letters, they can devote little attention to monitor and evaluate what is written. A common goal in teaching people to write is for them to become fluent and proficient with common production tools such as handwriting (Alves *et al.*, 2018). The basic idea is to make handwriting processes so automatic, they operate with little conscious attention. Even so, writers can and do intentionally think about their handwriting in certain situations, when a child writes a note to grandmother and tries to make every letter perfect, a signature is consciously produced with extra flourishes, or a writer decides to use a complex and exacting style like Spencerian script.

While the community in which writing takes place influences what production tools are used and how they are applied (Yancey, 2009), the WWC model also emphasizes that members of these communities can effect changes in how writing, including the use of handwriting, typically unfolds. For example, several members of a fund-raising community might convince their colleagues to send potential donors handwritten notes instead of the typed ones sent in the past, as the former will make their appeal more personal. Finally, just because a specific writing community employs a particular way of conducting business does not mean that all members will fall in line lockstep. Take for instance the English class described where texts are expected to be easy to read and pleasing to the eye. One or more students may consciously decide to write in their normally messy style because they are not motivated to do otherwise.

3. THE IMPORTANCE OF HANDWRITING FOR WRITERS' EDUCATION

Even with digital composing devices being used in more and more schools, handwriting is highly valued across the earliest writing communities that children belong to (school classes). In most countries, handwriting is the first taught writing modality and the dominant one throughout schooling. Rather than keyboards, pens (or pencils) are the preferred tool for learning to write and assessing knowledge, and most texts produced at school are written by hand in the majority of subjects and grade levels (Santangelo and Graham, 2016). This focus on handwriting at school communities is supported by empirical evidence showing the importance of this skill for literacy development. For example, research showed that, compared to other forms of practice (e.g., visual, auditory, or typing), handwriting facilitates the learning of letter symbols in both children

and adults (James and Engelhardt, 2012; Longcamp *et al.*, 2008, 2005). Thus, even in highly technological societies, the current pedagogical practices as well as the evidence on the importance of learning to write by hand support that, among the many production processes involved in writing (conceptualization, ideation, translation, transcription, reconceptualization), handwriting is one of the first ones that beginning writers need to master in order to work within the writing communities they partake in.

Though often seen as primarily a physical act, handwriting cannot be reduced to a set of fine motor skills exclusively related to the formation of letters (Graham and Weintraub, 1996). In alphabetic writing, handwriting involves other skills, such as orthographic coding, which draws on the letter forms stored in memory that need to be retrieved to produce letters by longhand (Berninger *et al.*, 1991b). Hence, for a writer to produce letters, words, and sentences by hand, he or she needs to articulate the motor demands of handwriting with the orthographic information about how letters are sequenced to form words. Handwriting is therefore a complex neuromotor skill that encompasses numerous cognitive and motor processes acting in concert. Van Galen (1991) integrated these processes within a single model of handwriting in alphabetic writing, in which handwriting production is viewed as the result of a series of processing modules hierarchically organized (handwriting has been less explored in other scripts, such as Chinese, but see Lam and McBride, 2018). There are high-level modules composed of central processes that deal with the abstract aspects of linguistic production (*viz.*, intentions, concepts, syntax, and spelling). The activation of these central processes – which are common to other linguistic tasks, such as speech (*cf.* Levelt, 1989) – is followed by the activation of peripheral processes included in the low-level modules (*viz.*, allograph selection, size control, and muscular adjustment). These peripheral processes activate the motor programs that contain information on letter shape, stroke order, and direction. Even though all modules can be activated in parallel during the execution of a handwriting movement, the higher modules are assumed to be activated before the lower ones. Simply put, handwriting relies on the close articulation between orthographic and motor skills (Christensen, 2004).

As postulated by the WWC model (Graham, 2018a, 2018b), an important condition for skilled writing is that the above-mentioned processes (and consequently, handwriting production) operate automatically, that is, with minimal attentional requirements. Until then, handwriting is a major constraint to writing performance. There is an increasingly amount of research showing a relationship between handwriting skill and writing achievement throughout schooling (Graham *et al.*, 1997; Limpo and Alves, 2013; Limpo *et al.*, 2017). Compared to legibility, handwriting fluency seems to impose more constraints on written composition (Santangelo and Graham, 2016). There are at least four reasons why poor and slow handwriting skills can compromise the development of expertise in writing.

First, handwriting is important to assure communication among the members of writing communities where this tool is used. Poor handwriting skills can

manifest in less legible texts, which in turn may influence readers' judgements about the quality of the presented ideas as well as about the writing ability of the writer. There is evidence suggesting that, compared to more legible texts, less legible texts are judged as being of poorer quality (Greifeneder *et al.*, 2012). On the one hand, reduced legibility may negatively affect readers by complicating their task of deciphering what is written and fully understand the message. Readers may either be forced to re-read passages and stop frequently to decode the message, or simply decide to disregard the least legible portions of the text. On the other hand, grounded on the idea that poor penmanship is typically ascribed to a bad writer, the other members of the community may also develop biased perceptions about the writing ability of the writer.

Second, the production process of handwriting may interfere with that of ideation. Slow writers may find it difficult to record their ideas at the pace at which they are able to generate them in their minds. In support of this claim, there is evidence showing that beginning and struggling writers tend to produce better texts in spoken than in written modalities (Bereiter and Scardamalia, 1987; Graham, 1990; Hayes and Berninger, 2010). A considerably slow rate of production in writing can easily hamper text production by reducing the amount of information and the degree of coherence of the written outputs (e.g., texts, notes, plans, etc.). For example, it may lead writers to forget already developed ideas resulting in several interruptions to recover the message, or it may impede writers to devote considerable attention to the most appropriate linguistic forms to accurately express an idea. Recently, Limpo and Alves (2017b) showed that the slow handwriting contributed to a slower production process and a poorer written text, by diminishing the number of words that a writer can produce without pausing (for 2 s or more) as well as by increasing the number of short pauses (below 2 s) produced during writing.

Third, until becoming automatic and fluent, the act of putting words onto paper imposes heavy demands on the limited capacity of working memory (Bourdin and Fayol, 2000; Olive and Kellogg, 2002). By requiring considerable attentional resources, the execution of fine-motor movements to produce letters and words reduces writers' capacity to allocate attention to other important writing processes, such as idea generation and language formulation (McCutchen, 2000). The high cognitive cost of non-efficient handwriting may therefore impede the recursiveness and interactivity among control and production processes, which is a characteristic of skilled writing (McCutchen, 1988). It may also constrain the employment of sophisticated planning and revising strategies in writing (Limpo and Alves, 2013). The use of these strategies is fundamental for producing high-quality texts, as they help writers not only to set goals and action plans that orient writing, but also to monitor their effectiveness and adjust them as needed.

Fourth, handwriting can also impact long-term memory resources (e.g., competence beliefs) and interact with modulators (e.g., emotions). The physical effort and cognitive demands associated with slow handwriting, sometimes coupled with

poor instruction (Santangelo and Graham, 2016) and unsupportive writing environments (Alves and Limpo, 2015a), may turn the act of producing a text into an arduous and eventually distressing experience. As a consequence, children may develop negative attitudes towards writing, which may ultimately give rise to a downward spiral characterized by low writing achievement, avoidance behaviors, and writing apprehension (Berninger *et al.*, 1991a, 1997). Slow handwriting seems also to be negatively related to writers' self-efficacy, that is, writers' perceptions about their ability to successfully achieve specific writing tasks (Limpo and Alves, 2013). Indeed, given that young writers consider linguistic and mechanical factors as key ingredients in good writing (Olinghouse and Graham, 2009), slow writers may be more prone to hold negative beliefs about their ability to produce texts. Holding negative self-efficacy beliefs for writing is problematic as there is considerable evidence showing their association with poor writing performance (Limpo and Alves, 2017a; Pajares, 2003).

Overall, given the importance of handwriting in shaping writing development within classroom writing communities, this foundational writing skill should be explicitly taught and systematically practiced during writers' education. Handwriting instruction is particularly important in primary grades, when children are beginning to learn to write. However, the achievement of handwriting automaticity takes several years, as shown by studies assessing handwriting throughout schooling.

4. ASSESSMENT AND TEACHING OF HANDWRITING

Handwriting can be assessed in terms of legibility and fluency (Graham *et al.*, 1998). Handwriting legibility can be defined as the extent to which written material is readable. One of the most valid and reliable instruments to measure legibility is the Test of Legible Handwriting (Larsen and Hammil, 1989). This test provides a legibility score ranging from 1 to 9 by comparing a sample of students' handwriting to a set of graded samples. The instrument relies on three handwriting samples collected in one copying task and two free-writing tasks. Measures of handwriting fluency tend to consider both accuracy and speed by taking into account the number of legible letters or words produced accurately and quickly within a specified time (e.g., Berninger *et al.*, 1992; Kim *et al.*, 2011). To avoid the interference of other processes within the writer's cognitive architecture (e.g., ideation, translation) that affect the rate of composing, handwriting fluency is typically assessed outside text production through alphabet and copy tasks. In alphabet tasks, writers are asked to write the lowercase letters of the alphabet as many times as possible during 15 s, 30 s, or 60 s. The final score is the number of letters correctly written, that is, legible out of context and in the right alphabetical order. In copy tasks, writers are asked to copy a paragraph or a sentence as many times as possible during 90 s. Usually, the final score is the number of words or letters correctly copied without any mistakes.

Alphabet and copy tasks are consistently used in the literature as valid and reliable indicators of a writer's handwriting fluency (Berninger *et al.*, 1992). By way of illustration, Table 1 presents the results obtained by Portuguese students from Grades 4–9 and undergraduates in the 15-s alphabet and 90-s copy tasks. Data was collected across different published studies (Limpo and Alves, 2013, 2018a, 2018b). As can be seen, at the end of primary school (age 10), fourth graders were able to produce 12 alphabet letters in 15 s and to copy 26 words in 90 s. However, in line with recent claims, handwriting continued to develop well beyond primary grades. From Grade 5 to Grade 9, children increase from 14.5 alphabet letters and 31 copied words to 22 and 41, respectively. Notable, the handwriting fluency of ninth graders is still below that of undergraduates, who are able to produce 25 alphabet letters in 15 s and to copy 44 words in 90 s. A similar growth pattern in handwriting throughout schooling has been reported for other countries, such as the United States (Graham *et al.*, 1998), or United Kingdom (Connelly *et al.*, 2007).

It is also worth noticing that research has also found gender differences in handwriting fluency. From very early on, girls seem to achieve higher levels of handwriting fluency than boys. In a study with children from Grades 1 to 3, Berninger and Fuller (1992) found a consistent superiority of girls over boys in the alphabet task as well as in a timed text production task. Alves, Branco, Castro, and Olive (2012) also showed that female fourth graders displayed higher compositional fluency than their male peers. Authors further examined this effect by looking at online writing measures, in particular, pauses above 2 s and bursts (i.e., number of words produced in-between pauses). Results showed that, during writing, boys tended to pause for a longer time than girls, and that girls produced longer bursts than boys. This study also showed that the quality of texts produced by boys (but not by girls) strongly benefit from removing handwriting constraints (i.e., text production through dictation). Recently, Cordeiro *et al.* (2018) provided additional evidence on the girl's superiority in writing by showing that, from Grade 4 to 9, girls consistently surpassed boys in measures of handwriting

TABLE 1: Handwriting fluency of Portuguese students in grades 4–9 and in college

Grades	N	Alphabet letters in 15 s		Copied words in 90 s	
		M	SD	M	SD
Grade 4	57	11.91	4.73	26.26	4.73
Grade 5	49	14.53	4.17	31.06	4.59
Grade 6	65	17.25	5.67	32.45	4.66
Grade 7	69	19.38	4.90	27.41	6.78
Grade 8	61	21.30	5.84	41.85	4.83
Grade 9	75	22.07	5.28	41.32	4.85
College	256	25.00	6.11	44.14	6.01

fluency. Also, authors showed that, girls' higher performance than boys in text production tasks was, at least in part, associated with this gender difference in handwriting fluency. As proposed by Graham and Weintraub (1996), individual differences in handwriting may be related to maturational delays and the neurological differentiation of the brain. For example, it was shown that the brain areas involved in language and fine-motor skills (such as handwriting) seem to mature earlier in girls than in boys (Hanlon *et al.*, 1999).

Together these findings agree well with current research suggesting that it takes a long time to become proficient in handwriting. Thus, rather than being restricted to primary grades, the development of handwriting fluency is a continuous process that takes place throughout schooling (Alves and Limpo, 2015b; Chartrel and Vinter, 2006; Graham *et al.*, 1998). Even so, handwriting automaticity is barely attained for some children and adolescents. For example, data from the study by Alves and Limpo (2015b) indicated that 10% of fifth, sixth, and seventh graders displayed a handwriting fluency similar to the average performance of third graders. In spite of that, explicit instruction in handwriting seems to occur only in the first years of learning to write.

For example, in Portugal, handwriting instruction mainly occurs in Grade 1 (Reis *et al.*, 2009). Typically, students are introduced to the cursive letters of the alphabet, which are practiced through the use of cursive letter models and sample words and sentences. There is also a focus on fine motor skills and capitalization rules, usually trained through letter writing and text copying. In these exercises, teachers seem to put a greater emphasis on using a 'careful calligraphy' instead of writing fluently. This focus on handwriting in the initial years of primary school is common to other countries, such as France (Bonneton-Botté *et al.*, 2018) or Spain (Jiménez and Hernández-Cabrera, 2018). Nonetheless, contrasting with the importance of handwriting to the acquisition and development of writing, few efforts have been made to systematically evaluate how the teaching of this skill is conducted in the classroom. Under the lens of the WWC model, such evaluation could focus on multiple characteristics of the writing community (e.g., purposes for writing and handwriting teaching practices) and of the teachers (e.g., degree of preparedness and beliefs about handwriting). The study of Graham and colleagues (Graham *et al.*, 2008) surveyed a random sample of 169 primary grade teachers from throughout the United States to examine if and how they taught handwriting in Grades 1–3. Results showed that primary grade teachers did teach handwriting, with 90% of them reporting to provide an average of 70 minutes per week of handwriting instruction, ranging from 2 minutes to 60 minutes per day. Nevertheless, teachers also indicated a lack of formal preparation to teach handwriting during college teacher education courses. About one half of the teachers reported to promote handwriting fluency by using copying exercises (56%) or by providing frequent writing opportunities (59%), but only a few used timed-writing exercises (7%). However, an optimistic finding was that almost all teachers (96%) recognized the importance of promoting handwriting fluency in beginning writers.

5. EVIDENCE-BASED PRACTICES TO PROMOTE HANDWRITING

Intervention studies have confirmed the importance of acquiring fluent handwriting for producing good writing. Considerable research found that instructional programs focused on students' handwriting skills resulted in impressive improvements in handwriting fluency as well as in written composition (Alves *et al.*, 2016; Berninger *et al.*, 1997; Graham *et al.*, 2000; Jones and Christensen, 1999; Limpo and Alves, 2018b; Limpo *et al.*, 2018). Recent findings from a meta-analysis suggested that, from kindergarten to ninth grade, students with and without handwriting difficulties benefited from explicit handwriting instruction (Santangelo and Graham, 2016). Specifically, findings showed that handwriting instruction resulted in strong and consistent benefits on handwriting fluency ($ES = 0.63$) as well as on the amount ($ES = 1.33$), quality ($ES = 0.84$), and fluency ($ES = 0.48$) of students' writing.

The ultimate goal of handwriting instruction should be to help students write letters, words, sentences, and connected text as legibly and fluently as possible (Graham, 2009). To achieve this goal, an essential component of handwriting instruction is practice in writing by longhand. Currently, there is no empirical evidence supporting the teaching of motor skills (Santangelo and Graham, 2016) or the use of other type of sensory-motor training without explicit handwriting practice as a way to improve handwriting (Hoy, Egan, and Feder, 2011). The frequency and amount of handwriting practice may vary according the characteristics of the writing community (e.g., instructional conditions, class frequency, production tools, etc.) and of its members (e.g., students' age, handwriting skill, proficiency in other production processes, etc.). Still, it is recommended that, during kindergarten and Grades 1–3, handwriting instruction should include distributed practice, up to a total of 50 to 100 minutes a week (Graham, 2009). In the literature, one can find effective handwriting programs providing a total of 6.6 to 20 hours of instruction, through biweekly to daily lessons lasting 10 to 30 minutes (Alves *et al.*, 2016; Berninger *et al.*, 1997; Graham *et al.*, 2000; Jones and Christensen, 1999; Limpo and Alves, 2018b).

As noted before, handwriting draws on the integration between orthographic and motor skills (Christensen, 2004). Thus, from the very beginning, children need to learn the name of the letters of the alphabet, to acquire an accurate representation of each letter, to match the letter name with its form, and to reproduce each letter in writing. As such, the initial stages of handwriting instruction should target the name and the form of each alphabet letter (Berninger and Graham, 1998). To improve accuracy and fluency in naming, identifying, and accessing letters, teachers may either name letters for students to recognize the matching form, or simply ask them to name each letter (Graham *et al.*, 2000). Effective exercises specifically aimed at teaching and training letter forms include the reproduction of letters in writing (a) after a careful examination of letter models with visual cues provided by numbered arrows indicating the nature, order, and direction of letter strokes, (b) after

teachers modeling of the motoric acts involved in producing the letter; (c) from memory, after a time-varying exposure period to letter models (Berninger *et al.*, 1997; Vinter and Chartrel, 2010). Together, these practices seem to help children to create accurate representations of letter forms in memory along with efficient retrieval routines. This can also be achieved through alphabet practice, which is a type of exercise included in almost all evidence-based handwriting programs proven to be effective (Alves *et al.*, 2016; Berninger *et al.*, 1997; Graham *et al.*, 2000; Jones and Christensen, 1999; Limpo and Alves, 2018b). Alphabet-writing exercises may include: drawing a line to join the alphabet letters in order while naming them, so to reveal a drawing, naming and/or writing the letter combing before, after, or before and after a given letter, organizing lists of words in alphabetical order, or fast writing of the alphabet starting either from the beginning or from the middle.

Once letter names and forms are acquired, students should also be given frequent opportunities for letter writing in the context of words and sentences (Graham, 2009). A common and effective exercise involves asking children to copy words and sentences. The material to be copied may contain the target letters of the lesson, letters that are difficult for children, or a particular combination of letters (Graham *et al.*, 2000). In copying exercises, students can be asked to copy colored words in order to sort them according to their color; to copy a list of numbered words in randomly numbered boxes; or to copy sets of six to ten sentences (Alves *et al.*, 2016; Limpo and Alves, 2018b). These exercises may be implemented under untimed or timed conditions. Untimed conditions may be useful for students to focus on letter forms, whereas timed conditions may allow them to improve fluency. As part of handwriting instruction, students should also be encouraged to practice handwriting in the context of composing. This may involve the establishment of other writing purposes, such as using handwriting to compose a text that will be read by community members. A relatively straightforward purpose (e.g., increasing handwriting legibility and fluency through isolated practice of letters and words), can then evolve to a more complex purpose (e.g., communicate with others, express feelings, record information, etc.) accomplished within a writing community operating under different assumptions from its multiple interacting forces. Having students to write frequently is an effective method for promoting handwriting legibility and fluency (Graham, 2009). Including this practice into composing may not only highlight the key role of communication in writing communities but also nurture members' motivation to write legibly and quickly by longhand. Children should additionally be asked to write as much as possible about motivating topics without other writing concerns, such as ideas quality or spelling correctness.

The majority of the above-mentioned practices are part of evidence-based handwriting instructional programs for primary-grade children. However, available evidence suggests that those exercises may be useful for middle-grade

students, particularly for those showing handwriting skills below grade expectations. Sizeable improvements in middle graders' handwriting skill and writing performance after handwriting instruction have already been reported (Christensen, 2005; Limpo *et al.*, 2018). For example, Limpo *et al.* (2018) implemented a handwriting intervention for students in Grade 5 with slower handwriting fluency compared to their peers. The program combined explicit instruction with intensive and systematic practice in writing cursive letters, words, and sentences fluently and accurately, through fast-paced activities to write the alphabet and copy words or sentences. After five hours of handwriting training, students' handwriting fluency increased to the level of their peers. Additionally, there were transfer effects to text production and enhanced self-efficacy. Having effective practices tailored to the needs of these older slow writers seems particularly important to remediate their writing difficulties, which can affect their academic success in the short- and long-term. Teachers can use these practices to help them to catch up with their classmates, fully develop their composing abilities, and nurture supportive writing-related beliefs.

6. FINAL CONSIDERATIONS

The current value of writing in contemporary nations is irrefutable. Writing is a pre-requisite for life-long learning and personal development, full engagement in civic life, and access to high-valued jobs. Even in an age where individuals grow up surrounded by digital devices, writing produced with pens (or pencils) continues to be highly valued in several writing communities pervasive in our society, such as classrooms in schools. One of the primary goals of formal education is therefore to build good writers, capable of using writing effectively within the private and professional communities of their lives.

As claimed in this article, one of the paths to achieve that goal is by promoting automaticity in orthographic-motor integration, through explicit and systematic training in handwriting. According to the research here reviewed, handwriting is not a mere physical act and both researchers and educators cannot afford to neglect it. There is sound evidence supporting the importance of handwriting to produce good texts. Specifically, until becoming sufficiently automatic, handwriting interferes with writing performance in several ways (e.g., low legibility hampers comprehension and slow fluency consumes attentional resources). Importantly, as illustrated with Portuguese data, this automatization process takes several years and research suggested that handwriting skill continues to increase well beyond primary grades (Alves and Limpo, 2015b; Graham *et al.*, 1998). Thus, across schooling, students should be provided with age-appropriate handwriting instruction, even in teenage school years when slow and debilitating handwriting is identified. As briefly described in the current article (for further detail, see Alves *et al.*, 2018), there is now a large array of evidence-based practices for effectively teaching and practicing handwriting. Most of these practices relying on regular handwriting training,

emphasizing legibility and fluency in writing letters, words, sentences, and texts. In sum, research has been indicating that an efficient and effective development of writing relies on good and fluent handwriting, which can be promoted through explicit and systematic training.

Of course, this is not to say that handwriting instruction is enough for students to develop the other processes of their cognitive architecture and to effectively operate within the characteristics of a writing community. To develop writers' ability to generate good ideas, express them into grammatically correct language, and build coherent and pleasing texts, specific writing instruction is also needed. Prior research has already shown the effectiveness of strategy-focused interventions to promote production processes, such as ideation or reconceptualization (e.g., Graham and Perin, 2007), inclusively in tandem with handwriting instruction in Grade 2 (Limpo and Alves, 2018b).

Nevertheless, for a comprehensive promotion of writing in general and of handwriting in particular, it is also important to initiate endeavors to target the characteristics of the writing community and the forces that shape them. For an effective and sustained development of handwriting, instruction should take account of the purposes to achieve (e.g., write faster, write better); the roles, responsibilities, and cognitive architecture of all members of the writing community (students as well as teachers); other writing tools that may assist writers (e.g., help with spelling, grammar, word choice, etc.); actions that may facilitate goals' adherence and keep members motivated; the different written outputs produced and their use to accomplish community purposes; and the physical and social conditions under which writing activities are enacted, which may facilitate or hinder learning. Likewise, instruction should be aware of the collective history and the macro-level forces that influence the construction and functioning of such a writing community. For example, ministerial guidelines and national curricula for the teaching of writing can surely shape the operation of writing communities in the classroom. If decision makers neither value handwriting instruction nor create conditions for it to happen, it will be difficult to create favorable conditions supporting the successful implementation of evidence-based programs within the multiple interacting forces of the community.

In sum, a comprehensive educational curriculum aimed at creating capable and motivated writers may rely on the solid foundations of effective handwriting instruction. However, as postulated by Graham's WWC model (Graham, 2018a, 2018b), such curriculum surely needs to simultaneously target other aspects that shape writing. Educating writers also entails targeting the writing community in which they partake along with other processes of the cognitive architecture they brought up to the writing task.

7. DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

8. FUNDING

This work was supported by the Operational Programme for Competitiveness and Internationalization, supported by FEDER and national funds allocated to the Portuguese Foundation of Science and Technology [NORTE-01-0145-FEDER-028404].

ORCID

Teresa Limpo  <http://orcid.org/0000-0002-9903-7289>

9. REFERENCES

- Alves, R. A. and Limpo, T. (2015a) Fostering the capabilities that build writing achievement. In P. McCardle and C. Connor (Eds) *Reading Intervention: From Research to Practice to Research* (Baltimore, MD, Brookes Publishing), 209–220.
- Alves, R. A. and Limpo, T. (2015b) Progress in written language bursts, pauses, transcription, and written composition across schooling, *Scientific Studies of Reading*, 19, 374–391. doi:10.1080/10888438.2015.1059838
- Alves, R. A., Limpo, T., Salas, N. and Joshi, R. M. (2018) Best practices in handwriting and spelling. In S. Graham, C. A. MacArthur and M. Hebert (Eds) *Best Practices in Writing Instruction* (3rd edn) (New York, NY, The Guilford Press), 211–239.
- Alves, R. A., Branco, M., Castro, S. L., and Olive, T. (2012). Effects of handwriting skill, effects of handwriting skill, handwriting and dictation modes, and gender of fourth graders on pauses, written language bursts, fluency, and quality. In V. W. Berninger (Ed) *Past, Present, and future contributions of cognitive writing research to cognitive psychology* (New York, NY: Psychology Press), 389–402
- Alves, R. A., Limpo, T., Fidalgo, R., Carvalhais, L., Pereira, L. A. and Castro, S. L. (2016) The impact of promoting transcription on early text production: effects on bursts and Pauses, levels of written language, and writing performance, *Journal of Educational Psychology*, 108, 665–679. doi:10.1037/edu0000089
- Bazerman, C. (1994) Systems of genres and the enactment of social intentions. In A. Freedman and P. Medway (Eds) *Genre and the New Rhetoric* (London, UK, Taylor & Francis), 67–86.
- Bazerman, C. (2016) What do sociocultural studies of writing tell us about learning to write? In C. A. MacArthur, S. Graham and J. Fitzgerald (Eds) *Handbook of Writing Research* (2nd edn) (New York, NY, Guilford Press), 11–23.
- Bereiter, C. and Scardamalia, M. (1987) *The Psychology of Written Composition* (Hillsdale, NJ, Lawrence Erlbaum Associates).
- Berninger, V. W. and Amtmann, D. (2003) Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: research into practice. In H. L. Swanson, K. R. Harris and S. Graham (Eds) *Handbook of Learning Disabilities* (New York, NY, The Guilford Press), 345–363.
- Berninger, V. W. and Winn, W. (2006) Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. A. MacArthur, S. Graham and J. Fitzgerald (Eds) *Handbook of Writing Research* (1st edn) (New York, NY, Guilford Press), 96–114.
- Berninger, V. W. and Fuller, F. (1992) Gender differences in orthographic, verbal, and compositional fluency: implications for assessing writing disabilities in primary grade children, *Journal of School Psychology*, 30, 363–382. doi:10.1016/0022-4405(92)90004-O

- Berninger, V. W., and Graham, M. (1998). Language by hand: A synthesis of a decade of research on handwriting. *Handwriting Review*, 12, 11–25.
- Berninger, V. W., Mizokawa, D. T. and Bragg, R. (1991a) Theory-based diagnosis and remediation of writing disabilities, *Journal of School Psychology*, 29, 57–79. doi:10.1016/0022-4405(91)90016-K
- Berninger, V. W., Vaughan, K. B., Abbott, R. D., Abbott, S. P., Rogan, L. W., Brooks, A. ... Graham, S. (1997) Treatment of handwriting problems in beginning writers: transfer from handwriting to composition, *Journal of Educational Psychology*, 89, 652–666. doi:10.1037/0022-0663.89.4.652
- Berninger, V. W., Yates, C. and Lester, K. (1991b) Multiple orthographic codes in reading and writing acquisition, *Reading and Writing: An Interdisciplinary Journal*, 3, 115–149. doi:10.1007/BF00420030
- Berninger, V. W., Yates, C. M., Cartwright, A. C., Rutberg, J., Remy, E. and Abbott, R. D. (1992) Lower-level developmental skills in beginning writing, *Reading and Writing: An Interdisciplinary Journal*, 4, 257–280. doi:10.1007/BF01027151
- Boekaerts, M. (2011) Emotions, emotion regulation, and self-regulation of learning. In B. J. Zimmerman and D. H. Schunk (Eds) *Handbook of Self-Regulation of Learning and Performance* (New York, NY, Routledge), 408–425.
- Bonneton-Botté, N., Bara, F., Marec-Breton, N., De La Haye-Nicolas, F. and Gonthier, C. (2018) Perception of the cursive handwriting movement in writers and pre-writers, *Reading and Writing*, 31, 927–943. doi:10.1007/s11145-018-9819-8
- Bourdin, B. and Fayol, M. (1994) Is written language production more difficult than oral language production? A working memory approach, *International Journal of Psychology*, 29, 591–620. doi:10.1080/00207599408248175
- Bourdin, B. and Fayol, M. (2000) Is graphic activity cognitively costly? A developmental approach, *Reading and Writing: An Interdisciplinary Journal*, 13, 183–196. doi:10.1023/A:1026458102685
- Cameron, C. A., Hunt, A. K. and Linton, M. (1996) Written expression as recontextualization: children write in social time, *Educational Psychology Review*, 8, 125–150. doi:10.1007/BF02160677
- Chartrel, E. and Vinter, A. (2006) Rôle des informations visuelles dans la production de lettres cursives chez l'enfant et l'adulte, *L'Année Psychologique*, 106, 43–64. doi:10.4074/S0003503306001047
- Christensen, C. A. (2004) Relationship between orthographic-motor integration and computer use for the production of creative and well-structured written text, *British Journal of Educational Psychology*, 74, 551–564. doi:10.1348/0007099042376373
- Christensen, C. A. (2005) The role of orthographic-motor integration in the production of creative and well-structured written text for students in secondary school, *Educational Psychology*, 25, 441–453. doi:10.1080/01443410500042076
- Connelly, V., Gee, D. and Walsh, E. (2007) A comparison of keyboarded and handwritten compositions and the relationship with transcription speed, *British Journal of Educational Psychology*, 77, 479–492. doi:10.1348/000709906X116768
- Cordeiro, C., Castro, S. L. and Limpo, T. (2018) Examining potential sources of gender differences in writing: the role of handwriting fluency and self-efficacy beliefs, *Written Communication*, 35, 448–473. doi:10.1177/0741088318788843
- De Beaugrande, R. (1978) Linguistic theory and composition, *College Composition and Communication*, 29, 134–140. doi:10.2307/357297
- Diamond, A. (2013) Executive functions, *Annual Review of Psychology*, 64, 135–168. doi:10.1146/annurev-psych-113011-143750
- Elbow, P. (1998) *Writing without Teachers* (2nd edn) (New York, NY, Oxford).

- Gabrial, B. (2008) History of writing technologies. In C. Bazerman (Ed.) *Handbook of Research on Writing: History, Society, School, Individual, Text* (New York, NY, Erlbaum), 23–34.
- Graham, S. (1990) The role of production factors in learning disabled students' compositions, *Journal of Educational Psychology*, 82, 781–791. doi:10.1037/0022-0663.82.4.781
- Graham, S. (2009) Want to improve children's writing? Don't neglect their handwriting, *American Educator*, 33, 20–40.
- Graham, S. (2018a) A writer(s) within community model of writing. In C. Bazerman, V. W. Berninger, D. Brandt, S. Graham, J. Langer, S. Murphy, P. Matsuda, D. Rowe and M. Schleppegr (Eds) *The Lifespan Development of Writing* (Urbana, National Council of English), 272–325.
- Graham, S. (2018b) The writer(s)-within-community model of writing, *Educational Psychologist*, 53, 258–279. doi:10.1080/00461520.2018.1481406
- Graham, S., Berninger, V. W., Abbott, R. D., Abbott, S. P. and Whitaker, D. (1997) Role of mechanics in composing of elementary school students: a new methodological approach, *Journal of Educational Psychology*, 89, 170–182. doi:10.1037/0022-0663.89.1.170
- Graham, S., Harris, K. R. and Fink-Chorzempa, B. (2000) Is handwriting causally related to learning to write? Treatment of handwriting problems in beginning writers, *Journal of Educational Psychology*, 92, 620–633. doi:10.1037/0022-0663.92.4.620
- Graham, S., Harris, K. R., Mason, L. H., Fink-Chorzempa, B., Moran, S. and Saddler, B. (2008) How do primary grade teachers teach handwriting? A national survey, *Reading and Writing: an Interdisciplinary Journal*, 21, 49–69. doi:10.1007/s11145-007-9064-z
- Graham, S. and Perin, D. (2007) A meta-analysis of writing instruction for adolescent students, *Journal of Educational Psychology*, 99, 445–476. doi:10.1037/0022-0663.99.3.445
- Graham, S. and Weintraub, N. (1996) A review of handwriting research: progress and prospects from 1980 to 1994, *Educational Psychology Review*, 8, 7–87. doi:10.1007/BF01761831
- Graham, S., Weintraub, N., Berninger, V. W. and Schafer, W. (1998) Development of handwriting speed and legibility in grades 1-9, *The Journal of Educational Research*, 92, 42–52. doi:10.1080/00220679809597574
- Greeno, J. G. and Engeström, Y. (2014) Learning in activity. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences* (2nd edn) (Cambridge, UK, Cambridge University Press), 128–147.
- Greifeneder, R., Zelt, S., Seele, T., Bottenberg, K. and Alt, A. (2012) Towards a better understanding of the legibility bias in performance assessments: the case of gender-based inferences, *British Journal of Educational Psychology*, 82, 361–374. doi:10.1111/j.2044-8279.2011.02029.x
- Hanlon, H., Thatcher, R. and Cline, M. (1999) Gender differences in the development of EEG coherence in normal children, *Developmental Neuropsychology*, 16, 479–506. doi:10.1207/S15326942DN1603_27
- Hayes, J. R. and Flower, L. (1980) Identifying the organization of writing processes. In L. W. Gregg and E. R. Steinberg (Eds) *Cognitive Processes in Writing* (Hillsdale, NJ, Lawrence Erlbaum Associates), 3–29.
- Hayes, J. R. and Berninger, V. W. (2010) Relationships between idea generation and transcription: how the act of writing shapes what children write. In C. Bazerman, R. Krut, K. Lunsford, S. Mcleod, S. Null, L. A. Rogers and A. Stansell (Eds) *Traditions of Writing Research* (New York, NY, Taylor & Francis/Routledge), 166–180.

- Hayes, J. R. (2012) Modeling and remodeling writing, *Written Communication*, 29, 369–388. doi:10.1177/0741088312451260
- Hidi, S. and Boscolo, P. (Eds.) (2007) *Writing and Motivation* (Amsterdam, Elsevier).
- Hoy, M. M. O., Egan, M. Y., and Feder, K. P. (2011). A systematic review of interventions to improve handwriting, *Canadian Journal of Occupational Therapy*, 78, 13–25. doi:10.2182/cjot.2011.78.1.3
- Hsiang, T. P. and Graham, S. (2015) Teaching writing in grades 4–6 in urban schools in the Greater China Region, *Reading and Writing*, 29 (5), 869–902. doi:10.1007/s11145-015-9597-5
- Hull, G. and Schultz, K. (2001) Literacy and learning out of school: a review of theory and research, *Review of Educational Research*, 71, 575–611. doi:10.3102/00346543071004575
- James, K. H. and Engelhardt, L. (2012) The effects of handwriting experience on functional brain development in pre-literate children, *Trends in Neuroscience and Education*, 1, 32–42. doi:10.1016/j.tine.2012.08.001
- Jiménez, J. E. and Hernández-Cabrera, J. A. (2018) Transcription skills and written composition in Spanish beginning writers: pen and keyboard modes, *Reading and Writing: An Interdisciplinary Journal*, 1–33. doi:10.1007/s11145-018-9928-4
- Jones, D. and Christensen, C. A. (1999) Relationship between automaticity in handwriting and students' ability to generate written text, *Journal of Educational Psychology*, 91, 44–49. doi:10.1037/0022-0663.91.1.44
- Kellogg, R. T. (1996) A model of working memory in writing. In C. M. Levy and S. Ransdell (Eds) *The Science of Writing* (Mahwah, NJ, Lawrence Erlbaum Associates), 57–71.
- Kim, Y.-S., Al Otaiba, S., Puranik, C. S., Folsom, J. S., Greulich, L. and Wagner, R. K. (2011) Componential skills of beginning writing: an exploratory study, *Learning and Individual Differences*, 21, 517–525. doi:10.1016/j.lindif.2011.06.004
- Lam, S. S.-Y. and McBride, C. (2018) Learning to write: the role of handwriting for Chinese spelling in kindergarten children, *Journal of Educational Psychology*, 110 (7), 917–930. doi:10.1037/edu0000253
- Larsen, S. and Hammil, D. (1989) *Test of Legible Handwriting* (Austin, TX, Pro-ED).
- Levelt, W. J. M. (1989) *Speaking: From Intention to Articulation* (Cambridge, MA, MIT Press).
- Limpo, T. and Alves, R. A. (2013) Modeling writing development: contribution of transcription and self-regulation to Portuguese students' text generation quality, *Journal of Educational Psychology*, 105, 401–413. doi:10.1037/a0031391
- Limpo, T. and Alves, R. A. (2017a) Relating beliefs in writing skill malleability to writing performance: the mediating role of achievement goals and self-efficacy, *Journal of Writing Research*, 9, 97–125. doi:10.17239/jowr-2017.09.02.01
- Limpo, T. and Alves, R. A. (2017b) Written language bursts mediate the relationship between transcription skills and writing performance, *Written Communication*, 34, 306–332. doi:10.1177/0741088317714234
- Limpo, T. and Alves, R. A. (2018a) Effects of planning strategies on writing dynamics and final texts, *Acta Psychologica*, 188, 97–109. doi:10.1016/j.actpsy.2018.06.001
- Limpo, T. and Alves, R. A. (2018b) Tailoring multicomponent writing interventions: the effects of coupling self-regulation and transcription training, *Journal of Learning Disabilities*, 51, 381–398. doi:10.1177/0022219417708170
- Limpo, T., Alves, R. A. and Connelly, V. (2017) Examining the transcription-writing link: effects of handwriting fluency and spelling accuracy on writing performance via planning and translating in middle grades, *Learning and Individual Differences*, 53, 26–36. doi:10.1016/j.lindif.2016.11.004

- Limpo, T., Parente, N. and Alves, R. A. (2018) Promoting handwriting fluency in fifth graders with slow handwriting: a single-subject design study, *Reading and Writing: an Interdisciplinary Journal*, 31, 1343–1366. doi:10.1007/s11145-017-9814-5
- Longcamp, M., Boucard, C., Gilhodes, J.-C., Anton, J.-L., Roth, M., Nazarian, B. and Velay, J.-L. (2008) Learning through hand- or typewriting influences visual recognition of new graphic shapes: behavioral and functional imaging evidence, *Journal of Cognitive Neuroscience*, 20, 802–815. doi:10.1162/jocn.2008.20504
- Longcamp, M., Zerbato-Poudou, M.-T. and Velay, J.-L. (2005) The influence of writing practice on letter recognition in preschool children: a comparison between hand-writing and typing, *Acta Psychologica*, 119, 67–79. doi:10.1016/j.actpsy.2004.10.019
- McCutchen, D. (1988) “Functional automaticity” in children’s writing: a problem of metacognitive control, *Written Communication*, 5, 306–324. doi:10.1177/0741088388005003003
- McCutchen, D. (1996) A capacity theory of writing: working memory in composition, *Educational Psychology Review*, 8, 299–325. doi:10.1007/BF01464076
- McCutchen, D. (2000) Knowledge, processing, and working memory: implications for a theory of writing, *Educational Psychologist*, 35, 13–23. doi:10.1207/S15326985EP3501_3
- Moje, E. (2009) Standpoints: a call for new research on new and multi-literacies, *Research in the Teaching of English*, 43, 348–362.
- Olinghouse, N. G. and Graham, S. (2009) The relationship between the discourse knowledge and the writing performance of elementary-grade students, *Journal of Educational Psychology*, 101, 37–50. doi:10.1037/a0013462
- Olinghouse, N. G., Graham, S. and Gillespie, A. (2014) The relationship of discourse and topic knowledge to fifth graders’ writing performance, *Journal of Educational Psychology*, Advance online publication. doi:10.1037/a0037549
- Olive, T. and Kellogg, R. T. (2002) Concurrent activation of high- and low-level production processes in written composition, *Memory & Cognition*, 30, 594–600. doi:10.3758/BF03194960
- Pajares, F. (2003) Self-efficacy beliefs, motivation, and achievement in writing: a review of the literature, *Reading and Writing Quarterly*, 19, 139–158. doi:10.1080/10573560308222
- Porter, D. (1962) The behavioral repertoire of writing, *College Composition and Communication*, 13, 14–17. doi:10.2307/354755
- Prunty, M. M., Barnett, A. L., Wilmut, K. and Plumb, M. S. (2013) Handwriting speed in children with developmental coordination disorder: are they really slower? *Research in Developmental Disabilities*, 34, 2927–2936. doi:10.1016/j.ridd.2013.06.005
- Reis, C., Dias, A. P., Cabral, A. T., Silva, E., Viegas, F., Bastos, G. ... Pinto, M. O. (2009) *Programas de português do ensino básico* [Portuguese Language Curricula for Basic Education] (Lisboa, Ministério da Educação).
- Russel, D. R. (1997) Rethinking genre in school and society: an activity theory analysis, *Written Communication*, 14, 504–554. doi:10.1177/0741088397014004004
- Santangelo, T. and Graham, S. (2016) A comprehensive meta-analysis of handwriting instruction, *Educational Psychology Review*, 28, 225–265. doi:10.1007/s10648-015-9335-1
- Schultz, K. and Fecho, B. (2000) Society’s child: social context and writing development, *Educational Psychologist*, 35, 51–62. doi:10.1207/S15326985EP3501_6
- Shanahan, C., Shanahan, T. and Misischia, C. (2011) Analysis of expert readers in three disciplines: history, mathematics, and chemistry, *Journal of Literacy Research*, 43 (4), 393–429. doi:10.1177/1086296X11424071
- Thorndike, E. (1910) Handwriting, *Teachers College Record*, 11, 83–175.
- Van Galen, G. P. (1991) Handwriting: issues for a psychomotor theory, *Human Movement Science*, 10, 165–191. doi:10.1016/0167-9457(91)90003-G

Vinter, A. and Chartrel, E. (2010) Effects of different types of learning on handwriting movements in young children, *Learning and Instruction*, 20, 476–486. doi:[10.1016/j.learninstruc.2009.07.001](https://doi.org/10.1016/j.learninstruc.2009.07.001)

Yancey, K. B. (2009) *Writing in the 21st Century: A Report from the National Council of Teachers of English* (Urbana, IL, National Council of Teachers of English).

Correspondence

Teresa Limpo

Faculdade de Psicologia e de Ciências da Educação

Universidade do Porto

Rua Alfredo Allen, Porto 4200-392, Portugal

Email: tlimpo@fpce.up.pt