

The Critical Role Handwriting Plays in the Ability to Produce High Quality Written Text

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Given the diversity and complexity of cognitive processes involved in the production of high quality written text, it seems counter-intuitive to suggest that handwriting is a key element in students' ability to create original and well-structured text. However, there is a sound theoretical basis and mounting empirical evidence to suggest that the relationship between handwriting and quality of written text is strong and surprisingly robust.

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The focus of handwriting in the curriculum for most of the last century was on legibility, neatness and strict motor-control. Good penmanship was central to curriculum in literacy for much of the twentieth century (Schlagal, 2007). However, more recently handwriting has been seen as unimportant and

irrelevant to contemporary education (Medwell and Wray, 2007).

Schlagal argues that in recent decades two factors have pushed handwriting to the margins of curriculum. There has been a de-emphasis on basic skills with their concomitant requirement for regimes of extended practice. A focus on spelling, grammar and handwriting has been replaced by an emphasis on personal communication. Second, the contemporary focus on electronic forms of communication, particularly in regard to word-processing has led some educators to argue that there is no longer any need to teach low-level skills such as handwriting (Schlagal, 2007).

In addition, it seems that research in the 1980's on emergent writing that demonstrated that children could create meaningful texts before having access to the formal writing system, led to a curriculum focus on semantics, creativity, genre and pragmatic awareness (Hall, 1987; Teale and Sulzby, 1986; Wray and Lewis, 1997) as well as a focus on processes such as planning, monitoring and revising (Hayes and Flowers, 1980) rather than an emphasis on handwriting-related skills such as letter formation and legibility (Medwell and Wray, 2007).

It seems ironic, then, that to some extent, when handwriting is

addressed in contemporary curriculum documents, the traditional emphasis found in early documents on neatness, motor control and script style remains (Medwell and Wray, 2007). Thus, current curriculum does not reflect recent research on the importance of handwriting or on the need for speed and fluency which underpins writers' ability to produce high quality written text.

Cognitive Demands of Writing. The multiplicity of cognitive processes involved in writing include: ideation related to the ability to generate original and creative ideas; syntactic awareness involved in production of grammatically accurate text; pragmatic awareness and sensitivity to audience required to produce text that communicates clearly and appropriately with the reader; technical accuracy related to spelling; and awareness of structural aspects of text such as genre. The number and complexity of these processes means that when attempting to produce text, novice writers can experience significant problems with capacity limitation of working memory or cognitive load.

Cognitive load refers to the attentional demands required to perform intellectual tasks (Sweller, 1988). Essentially the human mind has sufficient cognitive resources to attend to only one conscious intellectual activity at a time. Thus, attention is often referred to as the scarce cognitive resource (Lesgold, et al., 1988). This means that in order to perform complex intellectual tasks, an individual must be able to manage the potentially competing attentional demands that tasks may pose. This can be done in one of two ways. First, individuals can sequence tasks that have high cognitive loads. Process writing enables the writer to sequentially focus attention on one element of writing at a time.

This is effective in a number of situations, however, it is not possible to sequence all the attention consuming aspects of tasks at all times.

Automaticity provides the alternative to sequencing the cognitive processes needed to write (LaBerge and Samuels, 1974). Automaticity is defined as the ability to recall information from memory quickly, accurately and effortlessly (Schneider and Shriffrin, 1977). One characteristic of expertise is automaticity, so that experts have their knowledge available in a way that they can retrieve and use the information without consuming attention. This effortless retrieval of sub-components of complex tasks means that experts consume relatively few cognitive resources in the execution of low-level aspects of tasks and, therefore, have most of their attentional

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resources available for sophisticated, higher-order aspects of tasks (Bransford, et al., 2000). In other words, in addition to sequencing, expert writers can manage cognitive load through automaticity.

Handwriting is one aspect of written language that cannot be sequenced in order to manage cognitive load. If novice writers focus

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attention on the process of getting letters and words on the page, then they do not have sufficient attentional resources to focus on higher-order and centrally important processes such as ideation, pragmatic awareness or sensitivity to genre. Thus, theoretically, automaticity in handwriting is an essential prerequisite to the production of high quality, cre-

ative and well-structured written text. Indeed, over the last 20 years in addition to theoretical analysis, there has been a steady accumulation of empirical support for the notion that handwriting plays a central role in allowing the production of high quality written text.

Theoretical Aspects of Handwriting and Written Text. Graham, et al. (1997) argued that the necessity to switch attention from higher-order processes to the mechanical aspects of writing can interfere with planning, which in turn impacts on complexity and coherence of written work. They suggested that switching attention from the composing process to handwriting may affect the coherence and complexity of written work (Graham and Weintraub, 1996). Graham, et al. (2000) suggested that the need to switch attention from the composing process to the mechanical demands of handwriting, for example, having to think about how to form a particular letter, may result in a writer forgetting his or her ideas or plans for the text. McCutchen (1996) argued that the physical act of writing text is so demanding for young writers that they develop an approach to production of written text (knowledge telling), that minimizes the use of self-regulatory processes (e.g. planning, monitoring and revising). Thus, the cognitive load of handwriting, by exerting competing attentional demands, may make it difficult for the writer to translate his or her intentions into text.

In a review of literature, Berninger (1999) argued that there was substantial evidence to show that both transcription and working memory processes constrained the development of children's ability to compose text. This applied to children who were identified as learning disabled as well as children without learning disabilities.

In addition to problems with allocation of attention, if writers lack fluency in handwriting, they may not be able to get their ideas on the page fast enough to keep up with their thoughts. In other words, there is interference with content generation as well as with recall of ideas for text already planned. Graham and Weintraub (1996) argued that speed is an important aspect of handwriting. If handwriting is very slow, then students may not be able to record their thoughts in a way that keeps pace with their generation of ideas. Thus, they may forget their ideas before they get them on paper. Graham et al. found that speed of handwriting was significantly related to children's quality of composition.

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Berninger's simple view of writing (Berninger, Vaughn, Abbott, Begay, Coleman, Byrd, Curtain, Hawkins, Minch and Graham, 2002) suggested a theory of writing which consisted of three components. The first related to lower-level skill related to transcription including spelling and handwriting. The second refers to text generation processes or composing. The third related to executive functioning including planning, monitoring and revising. This model has underpinned a number of studies which have examined developmental processes contributing to children's ability to create written text.

Berninger, Mizokawa and Bragg (1991) developed a model which accounted for the relationship between lower-order skills, higher-order elements of writing such as composing and executive management, and performance on written tasks. This model was based on developmental constraints. They suggested that constraints operate at multiple levels in a dynamic relationship. Thus, Berninger, Yates, Cartwright, Rutberg, Remy and Abbott (1992) suggested that some sensory and motor capacities need to develop before the ability to integrate sensory-motor information, which underpins handwriting. This is followed by the development of higher-order cognitive skills related to writing. Berninger et al. argue that rapid coding of orthographic information, speed of finger movement and rapid production of alphabetic letters (orthographic-motor integration) may constrain the ability to transcribe ideas into text.

In addition to its impact on composition, handwriting can impact on children's attitude to writing. Berninger, Mizokawa, and Bragg (1991) suggested that if children find the acquisition of handwriting skill difficult, they tend to avoid writing tasks. This, in turn, impacts on their

sense of self-efficacy in regard to writing and, consequently, they display arrested development in writing. Graham and Weintraub (1996) also argued that students' motivation may be impacted because of experiences of frustration with the writing process.

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It should be kept in mind that handwriting is not just a motor act. It requires the integration of motor behaviour with knowledge of the orthography (Berninger and Graham, 1998). Memory for orthographic information, particularly letter shapes, contributes more to handwriting skill than

the motor component of writing. Orthographic-motor integration refers to ability to recall and produce letter shapes, groups of letters and words. Thus, handwriting requires the writer to mentally code and rehearse the visual representation of patterns of letters in words, and to integrate these patterns with motor activities (Berninger 1994).

Empirical Evidence for the Impact of Handwriting on Written Text.

While there is growing evidence that handwriting plays a significant role in writers' ability to produce written text, there is variability in some research findings. In part, this is due to diversity in data collection methods based on a range of assessment methods for both handwriting and composition of written text. Assessment of handwriting has included asking students to create a piece of text, to write letters of the alphabet from memory, to copy single letters, and to copy a piece of text.

There is also diversity in participants in research on handwriting. They have been drawn from a range of backgrounds and characteristics, including normally developing young, novice writers, older students and

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adults. Participants have included normally achieving students, as well as students with reading and writing disabilities. In addition to a range of data collection methods and participants, a variety of analysis techniques have been used, including correlational studies, structural equation modeling, quasi experimental and experimental designs.

Despite this variety in approach, there is consistency in a number of research findings. Much of the research has investigated the relationship between handwriting to two distinct aspects of written text. First, is compositional fluency which refers to the facility with which a writer

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can produce text. It is often measured by the amount of text produced in a specified time. Second, is the quality of written text. Measures of quality often consider issues such as: originality and creativity of thoughts and ideas contained in the text, logical sequencing and organization of the text, use of appropriate genre-specific structures, coherence of concepts expressed, detail and comprehensiveness of the coverage of the topic, sensitivity to audience, and clarity of expression which is underpinned by pragmatic awareness.

Research on handwriting and fluency of composition shows a strong and enduring relationship across a range of participant ages and methodological approaches. Research on handwriting and quality of written text is less consistent but nevertheless, points to a critically important variable.

It should be noted that the relationship between handwriting and fluency and quality of written text is due to working memory limitations and cognitive load. There is limited evidence for a relationship between appearance of handwriting and written text (Parker, Tindal and Hasbrouck, 1991).

As long ago as 1976 Rice found that for students in Grade 2, speed of handwriting predicted academic achievement as well as ability to complete written assignments. More recently, a number of studies have found significant correlations between fluency in handwriting and students' ability to produce written text. Biemiller, Regan and Gang (1993), working with children in Grades 1 to 6, reported correlations of between .34 and .76 between fluency of handwriting and fluency in composition. Similarly, Meltza, Fenton and Persky (1985) found correlations of .27 between speed of writing the alphabet and fluency in composition and .30 for quality of written text for students in Grades 4–9.

To more carefully control for influences involved in writing, Graham, Berninger, Abbott, Abbott and Whitaker (1997) used structural equation modeling to examine the relationships among handwriting, spelling and written language. They assessed 300 children in Grades 1, 2 and 3 (primary) and 300 children in Grades 4, 5 and 6 (intermediate) on two measures of handwriting: an alphabet task and a copying task. They also used a standardized spelling assessment and measured fluency and quality of composition. They found that mechanics related to spelling and handwriting accounted for 66% of the variance in compositional fluency in primary grades and 41% of the variance in intermediate grades. Mechanics accounted for a smaller proportion of the variance in quality of text; 25% in quality of composition for primary children and 42% of the variance for intermediate children. The impact of handwriting was also indicated in that Graham et al. reported that the relationship between spelling and composition was indirect and accounted for by its correlation with handwriting.

Jones and Christensen (1999), working with children in Grade 1 in Australia, found a much stronger relationship between speed and accuracy of handwriting and quality of written text than was observed in other studies. They found that when reading was controlled, handwriting accounted for 53% of the variance in written text.

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Using Berninger's et al. (1991) constraints model, Berninger et al. (1992) examined the hypothesis that development of written text consists of two components. First, a process of text generation allows the writer to convert ideas into spoken language. Second, a transcription process

converts spoken language into written text. They administered a number of measures to 300 children in Grades 1, 2 and 3. The data supported their hypothesis that text generation was followed by transcription. They found that lower-level developmental variables are related to early writing skill. Specifically, rapid, automatic production of alphabet letters, rapid coding of orthographic information and speed of finger movement were the best predictors of both handwriting and composition skills.

Taken as a whole, correlational studies indicate that the ability to produce letters automatically accounts for a remarkably large proportion of the variance in compositional fluency and, depending on the age of students, a large proportion of the variance in quality of written text.

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