TEACHING HANDWRITING: A COMPARISON OF RECOMMENDATIONS FROM RESEARCH AND THE NOVA SCOTIA CURRICULUM

by

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ABSTRACT

Handwriting is a necessary skill that also contributes to other learning. Information about how to structure a handwriting curriculum is available in the research literature, but handwriting often receives less formal instruction time than math and reading. This could be because of how handwriting instruction is framed in provincial curricula. English Language Arts curriculum documents for grades primary, one, and two in the province of Nova Scotia were reviewed in the context of evidence-based recommendations about teaching handwriting. The curriculum documents focused on the development of written composition skills rather than beginning handwriting skills. Implications for future curriculum documents, teacher training, and for school psychologists' assessment of students' handwriting are discussed.

Chapter 1: Literature Review

Handwritten work has played a key role in the documenting of history and shaping society into what it is today. Before the development of computer technology, handwriting served as a significant way for people to communicate and record events for later years. Handwriting is still used by many people for many reasons such as to make a quick grocery list, to record a telephone message, and to complete applications. Students are routinely required to handwrite information in class in the form of notes, while completing an examination, or to write down assignments from their teachers. McHale and Cermak (1992) and Marr, Cermak, Cohn, and Henderson (2003) estimated that young children spend between 31 to 60 percent of their time engaged in handwriting or other fine motor tasks. It could be argued that time spent on computers has reduced actual handwriting time in school, but handwriting skills are still important for students to be successful.

Poor handwriting has been found to have a negative impact on students in several ways. Research suggests that poor handwriting is correlated with weaker overall academic performance and weak learning confidence (Mather & Roberts, 1995). A study by Graham, Berninger, Abbott, Abbott, and Whitaker (1997) revealed that written composition performance was negatively impacted in terms of both the quality and quantity of writing in students with weaker handwriting skills. Additionally, lower grades have also been reported for students who display poor handwriting (Alston & Taylor, 1987). Despite the obvious importance of writing, it generally receives less emphasis than the other two Rs (reading and ‘rithmetic) in North American school curricula today (National Commission on Writing, 2003).

Automaticity and Fluency in Handwriting

Two important components which contribute to efficient handwriting are automaticity and fluency. Automaticity, as defined by La Berge and Samuels (1974), refers to the ability to complete a process swiftly, accurately, and without requiring conscious attention. The related term of handwriting fluency refers to the rate at which letters are produced (Deno, Marston, & Mirkin, 1982) and implies automaticity of respective writing movements (Wicki, Hurschler Lichtsteiner, Saxer Geiger, Muller, 2014). Multiple studies illustrate the importance of automaticity and fluency in handwriting (Medwell & Wray, 2007; Medwell & Wray, 2014; Wicki et al., 2014). Using the capacity based model of working memory (Just & Carpenter, 1992), once automaticity has been achieved then higher level cognitive processes involved in writing (composition planning, language generation, editing) can occur more easily and no longer are lower level processes straining working memory (Grabowski, 2010; Peverly, 2006).

The ability to automatically generate handwriting on paper without having to think about it is a predictor of handwriting speed as well as orthographic coding skills (Wicki et al., 2014). Orthographic coding refers to the processing of visual symbols of letter, clusters of letters, and words (Dinehart, 2015). In their study, Wicki et al. (2014) assessed 93 fourth graders' handwriting speed and legibility through use of a copying task. Additionally, a digitizing tablet was used to assess handwriting automaticity, and stroke pressure and frequency. Number of inversions in velocity (NIV), which takes into account the number of accelerations and decelerations per stroke, was used to measure automaticity. Visual-motor integration, or the ability of the eyes and hands to work together in smooth efficient patterns involving visual perception and eye-hand coordination (Beery, 1989), was also assessed using the Beery VMI (Beery, 2006). Orthographic skills were also further assessed using the Hamburger Schreibprobe

4-5, a standardized measure (May, 2002). The authors concluded that, when under time constraints, females wrote with a higher degree of automaticity than males, and left-handed individuals wrote with a lower degree of automaticity than right handed individuals. Relatedly, stroke frequency rates were also slower for individuals who were left-handed when compared to right-handed individuals. Importantly, when under time constraints, ten-year-olds were able to increase their automaticity level (as measured by NIV), despite the fact that as the authors state, most ten year olds do not have automaticity in their handwriting skills during this developmental period. Consistent with the suggestion set forth by Medwell and Wray (2007), Wicki et al. (2014) concluded that there was a need for teaching of handwriting during the first four years of schooling in order to increase automaticity of handwriting, as children may be able to attain more automaticity in their handwriting at earlier ages.

Medwell and Wray (2014) also examined the relationship of handwriting automaticity to composition skills. The study design involved gathering data from 186 students who were in Year 2 (grade one) and 198 students in Year 6 (grade five) at four randomly selected schools in England. Students in both groups completed handwriting Standard Assessment Tasks (SAT), which assessed handwriting style and neatness through a task requiring a sample of handwriting; a handwriting speed measure (Handwriting Speed Test), which asked participants to read and reproduce a sentence containing all alphabet letters as many times as possible in three minutes; and an alphabet task measuring handwriting automaticity by having participants write as many lower case letters of the alphabet in order as possible in one minute. They furthermore gathered measures of composition by asking participants to compose a longer and a shorter piece of writing which were then scored by teachers. Medwell and Wray (2014) discovered a very high correlation between performance on the alphabet task and composition performance, suggesting

that the ability to generate letters automatically was important in determining the composition level of students. Performance on the alphabet task also accounted for 34% of the variance in quality of composition amongst these participants. Thus, the study brings to light not only the importance of automaticity, but also the notion that higher level tasks involved with writing may suffer because generating the basic letters themselves likely also puts a strain working memory (Medwell & Wray, 2014).

Graphonomics research by Tucha, Tucha, and Lange (2008) has also contributed to understanding of the handwriting process and the role of attention in writing. Graphonomics refers to the interdisciplinary research field directed toward analyzing the relationships between the planning and generation of handwriting and drawing movements, the resulting spatial traces of handwriting and drawing instruments and the dynamic features of these traces (Tucha et al., 2008). According to the authors, graphonomic research places less emphasis on the style and neatness of handwriting. Rather, a focus on the spatial and kinematic processes involved in handwriting is thought to be important for efficient handwriting (Tucha et al., 2008). The authors of this article describe their research on adults who completed handwriting tasks that varied with respect to level of attention needed. One task involved subjects having to write sentences repetitively in forward or reverse (mirror) form. When the subjects performed mirror writing tasks or wrote non-words, greater attention was needed and automaticity of writing was impaired.

Cognitive Processes in Handwriting and Learning

It is evident that multiple cognitive processes (e.g., working memory, visual-motor intergration, attention) can influence handwriting ability because handwriting is a complex task that requires and strains multiple cognitive resources. Specifically, lower level tasks such as

planning and motor execution take up valuable cognitive resources until an individual develops ability to write easily and consistently for long periods (Peverly, Garner, & Vekaria, 2014). There is evidence to suggest that working memory, the cognitive space where information from the environment and long-term memory is held and manipulated to achieve remembering and learning (Baddeley, 2000) plays a role in writing quality (Peverly, 2006). As highlighted in Peverly's (2006) review article, multiple models of working memory seem to suggest that the most efficient way to maximize the benefits of our limited capacity working memory system is to teach and practice the basic skills. In this case, the development of basic letter formation and fluency and speed must be emphasized in handwriting so that working memory is no longer strained for these basic tasks, and optimal learning can occur.

Practicing handwriting until it is an automatic skill will not only allow for lower demand on working memory during the writing process but it could also have an impact on other areas of learning such as recognition of letters of the alphabet. Longcamp, Zerbato-Poudou, and Velay (2005) studied teaching stroke sequence to 76 children who were broken into two groups of 38 children. Participants' ages ranged from 3 years old to 5 years old. Each group learned to copy letters of the alphabet, either by hand or by keyboarding for three weeks, consisting of one half-hour session per week. Letter recognition was evaluated at the end of the three week training period and again one week later. Handwriting training helped children older than four to memorize letter forms. This was not seen in the participants who keyboarded. The authors noted that this was likely because keystrokes were not associated with a visual representation of a letter. The authors concluded that learning about handwriting could also help someone develop keyboarding skills because learning to form the shape of a letter could help with visual identification and discrimination of letters, necessary to develop good keyboarding skills.

More recent evidence for the processes involved with handwriting can be seen in recent research using neuroimaging while handwriting tasks are being performed. The contribution of cognitive neuroscience to learning has been described extensively by Dehaene (2011) who cites extensive studies which have used neuroimaging to demonstrate that academic tasks such as handwriting encourage brain activity in regions of the brain previously not anticipated.

James and Engelhardt (2012) examined the areas of the brain impacted when young students performed handwriting tasks and other tasks. In this study, the researchers recruited 15 participants (8 females, 7 males, ages 4 and 5 years old), who had not yet learned to handwrite. Participants were exposed to a letter or a shape on an index card and were asked to draw (which amounted to printing for the letters), trace, or type the letter or shape without the experimenter naming it (James & Engelhardt, 2012). Participants had contact with 12 letters and 12 shapes, four of each were given in each condition, and 12 more shapes were later given in the fMRI as controls. Specifically, in the first part of the research, participants were seated with the experimenter and underwent a single training session involving six conditions that were presented in random order. Participants were then asked to trace, draw, or type capital letters and shapes, repeating each action eight times with one stimulus before advancing to a different stimulus within the same condition. The experimenter held up the index card model throughout the trials, and the participant would then proceed to draw a symbol, which they would complete eight times under the same procedure. Once four letters and four shapes were drawn the child would move on to the next condition (typing). This training took approximately 30 minutes to complete.

Once participants were placed and comfortable in the fMRI, three or four functional runs were completed in which children were told to look at stimuli. Each run was 4 minutes and 55

seconds long and contained 8 blocks, 6 of which were training stimuli and 2 which were control stimuli. A 20 second fixation cross was shown after these functional runs before a first block was shown, consisting of 16 stimuli from one of the learned conditions. Blocks were separated by an interval 10 seconds in length, where only a fixation cross was shown. Each condition was repeated three times in random order within each block as there were only four training stimuli in each condition. The imagining session took approximately 20 minutes to complete.

A regions-of-interest (ROI) analysis was performed which analyzes anatomical localization of the anterior and posterior fusiform gyri in each participant's brain. The data from these regions were gathered and peak activation within each region was used as a data point. Results indicated from the ROI that the left fusiform gyrus was activated more after participants printed rather than typed, traced, or perceived letters (James & Engelhardt, 2012). The authors concluded that the ability to perceive letters can be aided by and is linked to handwriting experience and that this is an important finding given that the left fusiform gyrus is known to be involved in reading and letter processing (Flowers et al., 2004; Garrett et al., 2000; Schlagger & McCandliss, 2007).

Handwriting has also been shown to be important in the process of learning more broadly. Mueller and Oppenheimer (2014) devised a study in which participants were seated, generally two at a time, but sometimes alone, in a room which was preset with either a laptop or a notepad. One of five TED talks, all of which were deemed to be interesting but not common knowledge, was projected onto the board in front of the room. Participants were asked to use their usual note taking strategy. After 30 minutes had passed since seeing the mock lecture, participants were asked both factual-recall questions and conceptual-application questions about the lecture. The authors found that participants who took notes on a laptop tended to take

verbatim notes whereas handwriting note takers summarized information in their own words. Participants who took notes by hand did better than laptop note takers on tests covering both conceptual and factual content after the 30 minute delay and after one week. The authors noted that it was possible that the act of taking notes by hand could activate cognitive processes which contribute to long term learning.

Evidenced Based Approaches to Beginning Handwriting Instruction

Since learning to handwrite has broad implications for later learning, it is important to use sound evidence based approaches to handwriting instruction. During the early elementary years handwriting instruction is first introduced in a structured setting. The important skills of building automaticity and fluency in handwriting also begin in early grades and children who fail to develop these skills are likely to struggle with written expression later on (Graham & Harris, 2000; Graham, Harris, & Fink, 2000).

Berninger et al. (1997) screened approximately 700 students and identified 144 first graders at risk for handwriting difficulties who were randomly assigned to one of six conditions (motor imitation; visual cue; memory retrieval; visual cue + memory retrieval; copy; and the control group of phonological awareness). Five of the groups received different kinds of handwriting instruction that was delivered in groups of 3 students which met twice per week for 24 twenty-minute lessons. One control group received 10 minutes of phonological awareness teaching over the same time periods. Results indicated that children who received instruction involving the use of visual cues and memory retrieval tactics significantly improved their letter copying, word copying, and printing accuracy. Specifically, most improvement was noted when students were provided with numbered arrows as cues to the nature and order of strokes needed to produce a letter (visual cues) and required to cover letters and then write them from memory

Datchuk and Kubina (2012) conducted a literature review of 19 studies to analyze the effects of intervention on handwriting, sentence construction, and grammar. The participants in the studies were students in grades K-12 who received special Learning Disability services. The authors concluded that instruction in letter formation with visual cues led to enhanced handwriting performance across the studies where it was used. Datchuk and Kubina (2012) also offered several recommendations for primary grade teachers who have students who may not be showing development in writing.

Datchuk and Kubina (2012) suggested that teachers should practice modelling letter formation with visual cues and memory retrieval. The strongest support for this approach came from the Berninger et al. (1997) study where students showed handwriting improvement when they were provided with visual cues of arrows and numbers surrounding each alphabet letter as prompts for correctly forming letters and placing them in sequence. Students also benefited from viewing a correctly formed letter, covering the letter, producing the letter from memory, and comparing it with the letter that was presented to them initially.

Another suggestion Datchuk and Kubina (2012) provided is for teachers to monitor a student's progress by administering an alphabet or a copying task. An example of an alphabet task would be an activity where students have to write as many letters of the alphabet as they can remember in a certain time frame. In a related copying task, students would be provided words or sentences to simply copy down as quickly as they could over a certain period of time. Afterwards, the teacher would score the student's work based on the speed of work and how legible they produced their handwriting, and provide instruction on errors given (Datchuk & Kubina, 2012).

Datchuk and Kubina also recommended that teachers use orthographic coding activities in order to reinforce the names and shapes of letters. During reading or spelling activities for example, additional time could be set aside for teachers to introduce letter sounds or words. During an activity focusing on students learning the proper pronunciation of words, the student could also receive an activity which required them to write the letter out and practice writing it correctly.

Other kindergarten research explored potential component skills for beginning writers and its relation to their overall writing performance at the end of kindergarten. Twenty-one teachers from nine schools and 242 students were recruited from a larger study by Kim, Al Otaiba, Puranik, Folsom, Greulich, and Wagner (2011). In the larger study, classroom teachers in the treatment group were trained in the kindergarten version of Connor et al.'s (2009) Individualized Student Instruction (ISI), while classroom teachers in the waitlist control group received general professional development. Teachers in both groups attended a two-day workshop about the importance of teaching reading in an individualized way through individualized attention. The workshop included information about reading centers and provided training on the Response to Intervention (RTI) model. All teachers received progress reports with respect to student reading, but only teachers in the treatment (ISI) group obtained continued training with respect to individualized reading and biweekly in class support. Additionally, teachers in the ISI group were given software that provided recommendations for effective amounts and types of reading instruction that should be used with each student based on data. Oral language skills, spelling, letter writing fluency, and reading skills were measured, along with the ability to compose a brief narrative text. Data were collected in the fall, winter, and spring, with the spring assessments used because writing was only administered at this time

(Kim et al., 2011). The results revealed that oral language, spelling, and letter writing fluency displayed a unique relationship to the end of kindergarten writing performance. They concluded that all of these areas should be included in early writing instruction.

The importance of fluency in handwriting cannot be overstated, and a main challenge for beginning writers is learning how to write fluently enough to be able to express their ideas (MacArthur & Graham, 2013). The findings of Kim et al. (2011), that letter writing fluency is a contributor to end of kindergarten writing performance, highlights the importance of effective instruction surrounding such fluency building. Furthermore, evidence suggests that those who obtain instruction in handwriting produce longer, more fluent, and overall better pieces of writing (Santangelo & Graham, 2012), possibly because fluency with handwriting frees cognitive resources which can be focussed on the content of writing (Hayes & Chenowith, 2006). Finally, another body of research suggests that fluency building may prevent writing disabilities (Berninger et al., 2009; Graham et al., 2000). Berninger and Richards (2002) recommended that teachers ought to teach handwriting explicitly, teach in short sessions of no more than 10 minutes, and allow for practice after handwriting instruction.

Terminology: Printing and Cursive Writing

The term *handwriting* is used to refer to a number of different ways of getting written symbols onto paper using our hands. Generally there are two types of handwriting: printing and cursive. Printing (sometimes called manuscript writing) has traditionally been the first type of handwriting introduced to children. It is often introduced prior to school attendance in an attempt to get the child ready for school and then more formally in the early grades. Cursive writing has typically been introduced in later grades (Oliver, 1990 as cited in Feder & Majnemer, 2007). Graham and Weintraub (1996) suggested that neither script has proven to be more effective than

the other. Graham (2010) suggested that teachers begin with teaching printing. He noted that children will often have prior exposure to printing at home and that reading development may be facilitated by learning printing. Graham also stated that learning to print means that slanted printing that can be joined (D'Nealian writing) can be taught more easily later and that this type of handwriting can be performed as quickly as cursive writing. Berninger et al. (2006) noted that printing involves different processes than cursive writing and printing places fewer demands on cognitive and fine motor processes than cursive writing. It makes sense, therefore, that printing should be the initial focus for teaching younger children about handwriting.

Instruction in Sentence Construction

Once an individual is able to produce words accurately and fluently, it is important to also be able to learn how to combine strings of words to create sentences. Creating a sentence is not a simple task, and requires formulating an idea, retrieving words to match the idea, arranging words into correct sentence structures, and then possibly editing the message so that it makes more sense (Saddler, 2013). Such tasks are difficult for college aged students (Kellogg, 1987), let alone for children (Scardamalia & Bereiter, 1986). To construct a paragraph, the process of sentence construction must be completed over and over again placing even greater demands on the writer. Research into the writing process suggests that children learn how sentences are formed long before they begin to write because oral language provides the structure of how words are supposed to be combined (Saddler, 2013). Children then learn that noun-verb combinations form sentences, and that there are different kinds of sentences (Saddler, 2013). Being able to construct grammatically correct sentences is important so that grammatical errors, which distract the reader from attending to the overall writing, are not present (Saddler & Graham 2005). Evidenced based research in this area promotes explicit and systematic

instruction in sentence construction and sentence combining (Datchuk & Kubina, 2012; Graham & Perin, 2007; Saddler, Behforooz, & Asaro, 2008) to free cognitive resources needed for other writing processes (Graham, 1982).

The Datchuk and Kubina (2012) literature review provided support for teaching sentence construction, finding that students improved in sentence construction following instruction in simple or complicated sentence types. A model-lead-test approach (Archer & Hughes, 2011), which uses systematic and explicit instruction, was used in most studies that involved simple sentence instruction. This approach required instructors to model simple sentence construction using picture-word prompts. Participants then vocally described pictures and obtained immediate feedback about their description from an instructor. If the descriptions were deemed to be correct, then the participant transcribed sentences. Eventually, participants were able to compose compound or complex sentences, as instructors faded feedback assistance while teaching about subjects and verbs throughout. Datchuk and Kubina (2012) suggest that using picture word prompts allows individuals to shift their focus from generating ideas to describing pictures, which may decrease the difficulty of sentence writing. An additional model-lead-test formatted study by McCurdy, Skinner, Watson, and Shriver (2008) provided examples of complete and incomplete sentences to participants and had participants then choose from two story starters and write a composition. This method also proved beneficial.

Shumaker and Sheldon (1998) used a program for teaching simple sentence construction (Fundamentals of Sentence Writing) which involved having instructors model a strategy known as PENS MARK. PENS MARK is an acronym for: Pick a sentence formula, Explore word to fit the formula, Note the words, Search and check, Mark out the imposters, Ask if there is a verb, Root out the subject, and Key in on the beginning, ending, and meaning. By introducing this

approach and by fading assistance over time, participants displayed large increases in the number of complete and complex sentences (Bui, Schumaker, & Deshler, 2006).

Several studies in the Datchuk and Kubina (2012) review began with instruction in complicated sentence building, requiring instructors to model combining multiple simple sentences with adjectives, underlined phrases, and conjunctions. A peer-assisted learning strategy was also utilized in which one participant served as a player and another served as a coach who corrected and provided feedback during practice. Pairs then reversed and practiced performing each role. Multiple other studies further revealed that struggling writers receiving sentence-combining instruction outperformed struggling writers who received grammar instruction alone (Saddler & Graham, 2005; Saddler, Asaro, & Behforooz, 2008; Saddler, Behforooz, & Asaro, 2008).

Saddler and Graham (2005) used the Test of Written Language 3 (TOWL-3; Hammill & Larsen, 1996) to identify skilled and less skilled writers in fourth grade classrooms. Forty-four students were then randomly assigned into either a sentence combining instruction condition or a grammar instruction condition. Equal numbers of skilled and less skilled writers were assigned to each group and pairing occurred between skilled and less skilled writers. Each student pair received 30 lessons that were 20 minutes in duration and lasted for a period of 10 weeks. The sentence combining condition (Strong, 1986) aimed at improving sentence construction and focused on teaching how to combine smaller sentences into a compound sentence using *and*, *but*, and *because*. The first unit began with using *and* to form compound sentences. The next involved embedding an adjective or adverb from one sentence to another (e.g., combining *They run to the playground* and *They run quickly* to make *They run quickly to the playground*). The next lessons focused on creating complex sentences (e.g., combining *The students all cheered*

and *The game stopped* to make *The students all cheered when the game stopped*). The last units involved teaching students to combine what they learned in previous units. The procedure was such that the instructor modeled, and then had pairs of students practice orally while the instructor transcribed. Assistance was provided while the students practiced combining and transcribing on their own, with instructor assistance gradually faded over time enabling students to help one another. Lastly, instruction continued such that students moved from combining sentences using cues to other exercises where they were not to use cues. In the grammar instruction condition, participants were taught grammar and parts of speech to enhance vocabulary (Saddler & Graham, 2005). There were 5 units (verbs, nouns, adjectives, adverbs, subjects/predicates) taught similarly to the sentence combining condition with explicit instruction. Upon completion of the project, those students in the sentence combining condition improved in their story writing and were better at combining sentences into more complex sentences than students in the grammar instruction condition (Saddler & Graham, 2005).

In a 2012 meta-analysis, Graham et al. examined 115 studies that included 13 different writing interventions. They concluded that the need to provide students with explicit instruction in handwriting and writing strategies (including planning, drafting, and revising work) was supported by the literature. Graham et al. also noted that students from grades 1-3 benefited from being explicitly taught transcription skills such as spelling, handwriting, and keyboarding.

A series of scaffolding techniques also showed potential to improve writing in students (Graham et al., 2012). Scaffolding is a term first used by Jerome Bruner (1966), a cognitive psychologist who was interested in children's learning. His theory was that children could benefit from gradual assistance when learning a new skill until a time when they become independent and no longer need assistance. Much like scaffolding is used to support workers in

construction and then removed when no longer required, so too could supports be given to children to assist them in learning (Bruner, 1966). The application of this approach to learning to read and solve mathematical problems can similarly prove beneficial for handwriting and writing tasks. One scaffolding technique involved having students work together on activities involving writing. For students in grades 2-6, peer assistance ranged from helping one another with revising their written work, to generally helping each other throughout the writing process from start to finish. Results from such practices found improvements in the quality of written work. Assigning students in grades 2-6 pre-writing activities and making notes or drawing pictures prior to writing assignments also benefited students (Graham et al., 2012).

Specific methods of assessing and providing feedback about the handwriting and writing activities of students in grades 2-7 were also found to benefit their writing development (Graham et al., 2012). In some studies, students were taught to self-assess their writing ability, and in other research their peers were asked to provide the assessment and feedback. For other studies teachers or parents were tasked with determining the quality of the writing and providing suggestions for improvement. In general, students had better outcomes when adults, rather than students themselves or peers, were in the role of assessor (Graham et al., 2012). Graham et al. (2012) also found support for increasing the writing time allotted for students and introducing comprehensive writing programs.

To summarize, research findings support the idea that it is important to develop fluent handwriting to facilitate students' future success in other, more complex language arts activities. There have also been multiple cognitive processes associated with handwriting including attention (Peverly, 2006) and working memory (Tucha et al., 2008). While different processes may be involved with printing versus cursive writing, placing emphasis on teaching printing

before cursive writing is suggested by research (Graham, 2010). Finally, evidence based strategies are available to further develop students' handwriting abilities.

Chapter 2: A Summary of Evidence-Based Practices for the Effective Teaching of Handwriting in the Early Elementary Years

General Recommendations about Handwriting Instruction

General recommendations that are supported by research to be implemented in elementary classrooms include daily and frequent time devoted to teaching handwriting (Graham & Harris, 2002; Graham et al., 2008). Specifically, the large meta-analysis conducted by Graham et al. (2012) found that handwriting skills could be improved by increasing the amount of time that students wrote each day by as little as 15 extra minutes. Troia and Graham (2003) recommend providing handwriting instruction for between 75 and 100 minutes per week. Studies also support frequent, daily practice for short periods of time (Berninger at al., 1997; Graham et al., 2008), with one recommendation suggesting teaching for no longer than 5-10 minutes at a time (Berninger & Richards, 2002). The use of systematic and explicit instruction has also received widespread support, and is a key component of any handwriting curriculum (Graham et al., 2008; Graham & Harris, 2002; Troia & Graham, 2003). Additional general instruction in the form of guided practice, in which teachers allow for practice while giving oral directions, has been found to promote success (Graham et al., 2008; Graham & Harris, 2002), as has providing consistent feedback (Graham et al., 2008; Graham & Harris, 2002; Troia & Graham, 2003).

A Handwriting Curriculum

Research has shown that specific content areas are effective in increasing the handwriting skill of students. These include the explicit teaching of correct pencil grip and paper position (Graham & Harris, 2002; Troia & Graham, 2003), the teaching of letter formation and recognition (Berninger et al., 1997; Graham & Harris, 2002; Graham et al., 2008; Troia & Graham 2003), teaching with the goal of solidifying automaticity and fluency (Berninger et al.,

1997; Graham et al., 2008), and explicit and systematic teaching of sentence construction and sentence combining (Archer & Hughes, 2011; Datchuk & Kubina, 2012).

Research supports the explicit teaching of correct pencil grip and paper position (Graham & Harris, 2002; Troia & Graham, 2003). Graham (2010) recommended that teachers encourage and demonstrate proper pencil grip so that students do not form a grip that is likely to result in discomfort or fatigue. Graham (2010) encouraged teachers to demonstrate and encourage students to use an effective and efficient pencil grip such as a tripod grip. With respect to paper position, Graham (2010) also recommended that right handed individuals be taught to place their page directly in front of them with the left side of the paper at the centre of the body. For left handed writers, Graham (2010) recommended that individuals hold their paper somewhat clockwise and hold their pencil slightly farther back from the tip than right handed individuals. Graham (2010) also noted that all of these skills should be modeled and encouraged by teachers. Early handwriters may further benefit from being provided with wide lined paper and adjusting this as the student progresses (Graham, 1992).

It is also important to be able to recognize and name letters and to be able to write letters when they are named (Berninger & Graham, 1998; Graham 2010). Such skills can be accomplished by naming each letter when it is initially practiced, and through an alphabetic practice game in which students write the letter that comes after a string of five ordered letters and then the letter that comes before them (Brooks, Vaughn, & Berninger, 1999).

Teaching letter formation is another area identified in the literature as being important in increasing handwriting efficiency (Berninger et al., 1997; Graham & Harris, 2002; Graham et al., 2008; Troia & Graham, 2003). Guided practice, in which teachers provide sheets of letters that can be traced, can be a very successful starting point (Graham et al., 2008; Graham & Harris,

2002). Vander Hart et al. (2010) also suggested that teachers revisit alphabet letters with students periodically throughout the school year and model correct formation as a reminder. Research has also strongly supported the process of providing visual cues, such as numbered arrows, to aid in developing correct letter formation and construction because this allows students to clearly see the nature and the order of strokes involved in correct and efficient letter formation (Berninger et al., 1997; Datchuk & Kubina, 2012; Graham et al., 2008; Graham & Harris, 2002; Troia & Graham, 2003). Memory retrieval tactics of having the student look at the letter, cover the letter, and then try to construct the letter from memory are also recommended (Berninger et al., 1997; Graham et al., 2008).

To promote the important skills of building of handwriting fluency and speed (Berninger et al., 1997; Graham et al., 2008), Datchuk and Kubina (2012) advised administering an alphabet or copy task, such as having students write *the quick brown fox jumped over the lazy dog* (a sentence that contains all of the letters in the alphabet) as many times as possible under a timed constraint. Another method that could be used is to have the student produce the same letter as many times as possible under timed conditions in order to monitor students' progress towards becoming automatic and fluent writers (Alston & Taylor, 1987). Graham (2010) also suggested choosing a short paragraph from a grade-level book and having students spend ninety seconds copying the text. He further advised that additional handwriting instruction may be required for a student in the first, second, or third grade who produce below 7, 13, and 14 letters respectively (Graham, 2010). For grade one teaching specifically, Graham and Harris (2000) have devised the CASL (Center on Accelerating Student Learning) Handwriting Program which provides guidance for teacher-friendly effective instruction, includes all key content areas previously mentioned, and is available for free online.

Within the area of sentence construction and composition, evidence-based research strongly supports the use of explicit and systematic instruction (Archer & Hughes, 2011; Datchuk & Kubina, 2012). One effective method is a model-lead-test approach (Archer & Hughes, 2011) whereby teachers model sentence construction using picture-word prompts, students verbally describe the picture, students obtain feedback from the teacher, and the student transcribes correct sentence constructions into writing. With sentence combining, teacher modeling of combining sentences with adjectives, underlined phrases, and conjunctions as well as creating a peer-assisted learning environment where students provide feedback to one another, were shown to be helpful in several studies highlighted in Datchuk and Kubina's (2012) meta-analysis. Additionally, Saddler (2013) advocated for a learn-see-do approach to sentence combining in which teachers model how and why sentence combinations are made, use scaffold practice in which they guide students to develop solutions to a problem, and allow for independent practice where students create solutions to a problem which are then discussed and evaluated by the whole class.

Despite a significant body of research which provides information about how to effectively teach handwriting skills, evidence exists that these practices are not always implemented. Vander Hart et al. (2010) examined the handwriting teaching practices of teachers in four kindergarten classes to evaluate whether the teaching approaches were aligned with evidence-based research. The authors looked at the handwriting curriculum and recorded instructional practices at various points during the school year. Handwriting samples of the students were also obtained at several points. In addition, teachers completed a survey about the instructional techniques that they used when teaching handwriting at the beginning, middle, and end of the school year. The survey also asked teachers to rate the importance of several

evidence-based instructional practices and the amount of time devoted to handwriting teaching (Vander Hart et al., 2010). Teachers also completed a handwriting instruction log during a one-week period at the beginning, middle, and end of the school year and participated in interviews with the researchers. Researchers spent time observing classrooms to identify evidence-based practices being implemented in the classroom and to compare this data to teacher self-report. Lastly, student handwriting samples were obtained by researchers using a copy task and an alphabet task. These samples were compared to report card grading (Vander Hart et al., 2010). The authors concluded that teachers implemented some effective strategies but that improvement could be made within the areas of daily explicit instruction, handwriting fluency, handwriting from memory, and self-monitoring. The authors further determined that teaching quality and the learning of handwriting skills suffered due to the lower level of emphasis on implementing these practices.

When to begin Teaching Handwriting

Graham, Harris, and Larsen (2001) stated that, without a doubt, the best way to prevent writing difficulties is to begin implementing evidence-based instruction in kindergarten and grade one. The authors noted that this is advantageous because it will help maximize children's writing development, will minimize the number of children who struggle with writing due to poor instruction, and will also help those children whose writing problems are not a result of instruction but are due to other factors such as a learning disability. Vander Hart et al. (2010) highlighted that handwriting instruction is expected to be a part of a kindergarten curriculum. Specifically, children in this grade are expected to be introduced to printing, to be able to independently form a number of uppercase and lowercase letters, to be able to write their first and last names, and to be able to order sentences by the end of the year (Edwards, 2003;

Massachusetts Department of Education, 2001; Snow, Burns, & Griffin, 1998; as cited in VanderHart et al., 2010). Graham (1992) asserted that children need to learn correct letter formation early, as it is very difficult to unlearn motor skills.

Despite a substantial body of research focusing on content and methods that should be included in handwriting curricula, Phelps and Stempel (1989) hypothesized that teachers may have difficulty implementing evidence-based practice when teaching handwriting because they have not received strong training in this area. This statement is supported by findings of Graham et al. (2008) who surveyed teachers in grades primary to three and found that teachers did not have a solid understanding of the development of handwriting and displayed mistaken beliefs in what they thought was effective instruction. In addition to this, only 39% of teachers in this study described their students' handwriting as being adequate and teachers reported that less than half of their students were able to handwrite quickly enough to keep up with classroom tasks. Since the beliefs and practices of teachers typically may not align with suggested handwriting instruction, it is necessary to review the curriculum materials provided to teachers to determine the focus.

Chapter 3: The Nova Scotia English Language Arts Curriculum

The Nova Scotia English Language Arts curriculum (Nova Scotia Department of Education and Early Childhood Development [NSDEECD], 2015a) is a document which presents the department's expectations for the teaching of handwriting content and methods. Just recently revised, this guide has been provided to teachers for use in schools starting in September 2015. The document was provided to those who were invited to attend a workshop in the spring of 2015, but unlike other curriculum documents, the new Language Arts curriculum is not currently available on the Nova Scotia Department of Education and Early Childhood Development's website. This new Language Arts curriculum, which will be discussed in this section, will hereafter be referred to as *the Language Arts curriculum* or, more simply, as *the curriculum*. In a media release, the Minister of Education and Early Childhood Development stated that the new Language Arts curriculum is comprised of two-thirds fewer learning outcomes than the old curriculum (Nova Scotia Department of Education and Early Childhood Development, 2015b).

The new curriculum has a number of general curriculum outcomes for each grade and specific performance indicators that highlight key features and narrows the focus of teaching (Nova Scotia Department of Education and Early Childhood Development, 2015a). The outcomes for the Language Arts curriculum are largely focused on reading, speaking, listening, and viewing. The outcomes for writing are not grouped together in any specific fashion. Rather, they are scattered in amongst other Language Arts outcomes.

The first writing outcome presented is "Outcome 6: Students will convey meaning by creating print and digital texts collaboratively and independently using imagination, personal experiences, and feelings" (NSDEECD, 2015a). For grade primary, specific performance

indicators within this general outcome state that students are expected to understand that print carries a message; to play with words and sounds to express an idea; to begin to label some drawings to explain some ideas/topics; and to begin to understand readers'/listeners' comments to clarify meaning. For grade one, specific performance indicators in Outcome 6 include an understanding that writing and other forms of representing convey meaning; to express ideas in complete thoughts; to label drawings to explain ideas/topics; and to understand readers'/listeners' comments to clarify meaning. Performance indicators for students in grade two state that they will be able to express ideas in complete thoughts using simple and compound sentences; label drawings to explain ideas/topics; and to understand and begin to use readers'/listeners' comments to clarify meaning (NSDEECD, 2015a).

The next writing focused outcome is "Outcome 7: Students will be expected to use writing and other forms of representation including digital to explore, clarify, and reflect on their thoughts, feelings, experiences, and learning" (NSDEECD, 2015a). For grade primary, specific performance indicators state that students are to be able to write, using drawings, combinations of letters with some sound associations and known words to talk about their writing or reading the text they wrote; to begin to talk about word choice; and to create and record questions in print or digital format. For grade one, specific performance indicators within Outcome 7 state that students are expected to be able to write, using drawings, combination of letters with some sound associations and known words, a variety of poetry, fiction, and non-fiction texts to explain thinking, feelings, and ideas; to record experiences and personal opinions in both print and/or digital format; to inform and communicate information; to be able to begin to explain the purpose for their writing; to begin to make decisions about word choice for specific reasons-concrete nouns, precise verbs, description; and to create print and digital texts (draw or write)

with a beginning, middle, and end. Under Outcome 7 for grade two, performance indicators state that students are expected to write a variety of poetry, fiction, and non-fiction texts; to explain the purpose for their writing; make decisions about word choice for specific reasons - concrete nouns, accurate verbs, description etc.; create and record questions both in print and/or digital format; write in both print and/or digital format an organized text with a beginning, middle, and end; begin to select appropriate print and/or digital graphic organizers from several options; and recognize differing points of view in own writing and the writing of others (NSDEECD, 2015a).

The next outcome that involves writing is "Outcome 8: Students will be expected to create text, including digital, collaboratively and independently using a variety of forms for a range of audiences and purposes" (NSDEECD, 2015a). For grade primary, performance indicators include identifying audiences for some of their writing; to explain the reason for their writing; and to work with a partner, in small groups, and independently to create writing (e.g. lists, notes, stories, poems). For grade one, performance indicators state that students are able to identify different forms of print and digital writing that are appropriate to specific purposes and audiences, identify print and digital information that is relevant and purposeful for an intended audience; and work with a partner, in small groups, and independently to create writing in both print and digital format. In grade two, students are to begin to choose forms of writing that are appropriate to specific purposes and audiences; begin to include information that is relevant and purposeful for an intended audience; and to work with a partner, in small groups, and independently to create writing (NSDEECD, 2015a).

Additional Provincial Documents

The focus of the curriculum is largely on the content of what is expected from the outcomes, rather than teaching methods. Another teacher focused document, Teaching in Action,

Grades Primary-3, (Nova Scotia Department of Education, 2006), offers some suggestions on how teachers can help children achieve writing goals and refers to strategies such as explicit teaching, modelling, scaffolding, and working in groups; however, specific teaching guidance within these domains is not the focus. This document, much like the new Language Arts curriculum, emphasizes the writing process and the development of written composition skills across grades. The Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document supports modelling and scaffolding of how to write various forms of text (nonfiction, fiction, poetry), and notes that the teacher may need to provide a high level of scaffolding and modelling in written composition if the student is not progressing.

Related to the development and implementation of the new Language Arts curriculum, the government of Nova Scotia also published Nova Scotia's Action Plan for Education (Nova Scotia Department of Education and Early Childhood Development [NSDEECD], 2015c). The document mentions a number of key initiatives, one of which is to "teach reading, writing, and speaking skills across subject areas so that students may develop stronger communication skills" (NSDEECD, 2015c, p.23). This document notes that the new Language Arts curriculum will aim to provide students with increased instructional time for learning spelling, punctuation, and the formation of sentences and paragraphs. The Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document is also supportive of the notion that teachers should aid developing writers so that students feel successful with writing stating that "with emergent writers the teacher is often the scribe, typing or copying the student's work, so he or she can have the satisfaction of a professional looking product to celebrate" (Nova Scotia Department of Education, 2006, p.8).

Chapter 4: Comparing the Nova Scotia Curriculum to the Research

The purpose of this chapter is to use the summary of evidence-based handwriting research from Chapter 2 to examine the new Language Arts curriculum. Specifically, it will examine whether curriculum content evidence-based practices recommended in research are components of the new curriculum.

General Recommendations about Handwriting Instruction

Research supports daily and frequent time devoted to teaching handwriting (Berninger et al., 1997; Graham & Harris, 2002; Graham et al., 2008; Graham et al., 2012; Troia & Graham, 2003). Increasing the amount of handwriting time by as little as 15 minutes per day can improve handwriting skills (Graham et al., 2012), and Troia and Graham (2003) have recommended providing handwriting instruction for 75 to 100 minutes per week (Troia & Graham, 2003). While there is no mention of providing daily and frequent time devoted to teaching handwriting in the new Language Arts curriculum, there is mention of providing more writing time in the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document. Specifically, the Teaching in Action, Grades Primary-3 document (Nova Scotia Department of Education, 2006) states that, as an educational system, we need "regular scheduled time for writing" and "ample time for writing so students can practice and understand the connection between word study and real writing." There is no specific guidance or clarification with respect to frequency or length of time that should be devoted to handwriting instruction.

Another practice widely supported by research is the use of systematic and explicit instruction (Graham et al., 2008; Graham & Harris, 2002; Troia & Graham, 2003). The new Language Arts curriculum (NSDEECD, 2015a) does not mention these principles in the outcomes. The Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education,

2006) mentions teaching explicitly with respect to teaching the different forms of writing (narrative, expository, descriptive, persuasive), and to provide "explicit instruction on text features and their purposes, in reading and in writing (Nova Scotia Department of Education, 2006, p. 47) but makes no specific mention of teaching beginning handwriting skills explicitly and/or systematically.

Two final general recommendations provided in the research are the use of guided practice, in which teachers allow for practice while giving oral directions (Graham et al., 2008; Graham & Harris, 2002), and providing consistent feedback (Graham et al., 2008; Graham & Harris, 2002; Troia & Graham, 2003). The new curriculum (NSDEECD, 2015a) does not make mention of these practices. The Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document does, however, state that scaffolding support should be provided through demonstration and shared and guided practice, and suggests that teachers work with students in groups or individually with monitoring of each individual's strengths and needs. The final general recommendation of providing consistent feedback (Graham et al., 2008; Graham & Harris; Troia & Graham, 2003) is not mentioned in the new Language Arts curriculum (NSDEECD, 2015a) but is mentioned multiple times in the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document. The document suggests that teachers should provide feedback whether the student is working in a group setting or independently.

A Handwriting Curriculum

The literature highlights a number of specific content areas that should be focused on when teaching early handwriting skills. Two practices supported by research are the explicit teaching of correct pencil grip and proper paper position (Graham & Harris, 2002; Troia & Graham, 2003). Graham (2010) recommended that teachers encourage and model how to

properly grip a pencil using an effective grip (e.g., the tripod grip). With respect to paper position, Graham (2010) recommended that, for right-handed students, teachers model and encourage placing the page directly in front of them with the left side of the paper at the centre of the body. For left-handed individuals, Graham (2010) recommended that teachers model and encourage holding the paper somewhat clockwise while also having students hold their pencil slightly farther back from the tip than right-handed individuals. Providing wide-lined paper is also deemed as being useful for beginning handwriters (Graham, 1992). None of these practices are mentioned in either the new curriculum (NSDEECD, 2015a), or the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document.

The recognition and naming of letters and being able to write letters when they are named are other important curriculum content supported in the literature (Berninger & Graham, 1998; Graham, 2010). These skills can be developed by associating a name with each letter when it is initially being written, and by an alphabetic practice game where students are given a string of five ordered letters and then asked to write the letter that comes before the string and after the string (Brooks, Vaughn, & Berninger, 1999). Neither of these skills are mentioned in either the new curriculum (NSDEECD, 2015a), or the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document.

Teaching letter formation is an additional evidence-based practice identified in the literature (Berninger et al., 1997; Graham & Harris, 2002; Graham et al., 2008; Troia & Graham, 2003). Guided practice is understood to be a successful starting point, whereby teachers provide sheets of letters that can be traced (Graham et al., 2008; Graham & Harris, 2002). Providing visual cues, such as numbered arrows, aids in helping to develop correct letter formation as students are able to clearly see the nature and order of strokes involved (Berninger et al., 1997;

Datchuk & Kubina, 2012; Graham et al., 2008; Graham & Harris, 2002; Troia & Graham, 2003). Memory retrieval tactics of having the student look at a letter, cover the letter, and then reproduce the letter from memory is also supported (Berninger et al., 1997; Graham et al., 2008). Another body of research also suggests that teachers periodically revisit letters previously taught and model correct formation as a reminder (Vander Hart et al., 2010). As previously mentioned, guided practice is listed as a general practice recommended to be included when teaching writing in the Teaching in Action, Grades Primary-3 document (Nova Scotia Department of Education, 2006). However, there is no mention of teaching letter formation in either the new Language Arts curriculum or the Teaching in Action, Grades Primary-3 document.

Developing handwriting fluency and speed are other important skills that research suggests are important when teaching handwriting (Berninger et al., 1997; Graham et al., 2008). This can be aided by administering an alphabet or copy task, whereby students write a sentence that contains all the letters in the alphabet as many times as possible under timed constraints (Datchuk & Kubina, 2012), or by writing the same letter as often as possible under timed constraints (Alston & Taylor, 1987). These methods help teachers to monitor students' progress towards becoming automatic and fluent writers. These techniques can also be used to identify students who need further handwriting support (Graham, 2010). There is no outcome within the new Language Arts curriculum (NSDEECD, 2015a) which focuses on building handwriting fluency and speed, nor is there mention of this in the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document, apart from a mention that, eventually, students should become fluent writers.

Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) mentions some of the general recommendations that are supported by evidence-based research.

These include the importance of devoting significant time to writing in classrooms and a mention of explicitly teaching some writing concepts. The importance of guided practice and scaffolding along with providing consistent feedback to students on their performance are also highlighted. It is important to note, however, that these components are mentioned in the context of developing written composition skills rather than handwriting skills. No general recommendations to assist with developing handwriting skills are provided.

In terms of providing specific handwriting content to be taught, neither the new Language Arts curriculum (NSDEECD, 2015a) nor the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document include any recommendations for content to be included when developing handwriting skills. Consequently, the method for how to teach these research-supported content areas to develop handwriting skills is also absent from both the new Language Arts curriculum (NSDEECD, 2015a) and the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document. Thus, teachers and other educational personnel are left without direction about what specific handwriting skills to teach children and which explicit strategies would be helpful to use in the development of handwriting skills.

Chapter 5: Recommendations and Implications

After reviewing the literature with respect to evidence-based practices for teaching handwriting as well as the new Language Arts curriculum (NSDEECD, 2015a) and the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document, it is possible to conclude that the curriculum mentions some general recommendations that are supported by research with respect to teaching written composition, but that no information exists with respect to teaching handwriting in either document. These existing problems with the curriculum have implications for professionals (e.g., teachers and school psychologists) working in the education system.

Curriculum Recommendations

General Recommendations about Handwriting Instruction. In terms of general recommendations for developing students' handwriting skills, it is evident through examination of the new Language Arts curriculum (NSDEECD, 2015a) and the Teaching in Action, Grades Primary-3 document (Nova Scotia Department of Education, 2006) that there is a focus on the development of written composition skills but no mention of developing handwriting skills in either document. The Teaching in Action, Grades Primary-3 document (Nova Scotia Department of Education, 2006) mentions the general evidence-based practices of increasing the amount of handwriting instructional and practice time, along with recommending that teachers teach explicitly. What is not provided in this document or in the Language Arts curriculum is guidance with respect to the frequency and length of time that is suggested for handwriting instruction and practice. Nor are there practice and guidance activities listed with respect to the explicit and systematic teaching of handwriting. It would be beneficial for the curriculum to provide more guidance within these areas, and to suggest that handwriting instruction be provided to students

for between 75 to 100 minutes per week, based on the recommendation of Troia and Graham (2003). The curriculum should also consider highlighting that handwriting lessons and practice should be implemented daily and need not last for longer than ten minutes at a time (Berninger et al., 1997; Graham et al., 2008). A focus on explicit and systematic instruction within the area of developing beginning handwriting skills is also recommended (Graham et al., 2008; Graham & Harris, 2002; Troia & Graham, 2003).

Other general evidence-based practices of providing guided practice and scaffolding, and providing feedback to students with respect to composing and understanding different kinds of texts, are described in the Teaching in Action, Grades Primary-3 document (Nova Scotia Department of Education, 2006). This same method of providing guided practice can be implemented for teaching beginning handwriting skills, where teachers give oral directions and allow for practice (Graham et al., 2008; Graham & Harris, 2002). The Teaching in Action, Grades Primary-3 document (Nova Scotia Department of Education, 2006) highlights the importance of providing feedback to students both individually and in groups. This practice is also supported in the literature (Graham et al., 2008; Graham & Harris, 2002; Troia & Graham, 2003) and should be encouraged.

A Handwriting Curriculum – Recommendations for Content and Methods. No mention of any of the specific evidence-based content and teaching methods identified in research as being important for handwriting development (see Chapter 2) is made in either the new Language Arts curriculum (NSDEECD, 2015a) or Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006). The recommendations about evidence-based content and methods from research include the explicit and systematic teaching of proper paper positioning and proper pencil grip; explicitly teaching letter recognition and letter formation; and

teaching with the goal of solidifying automaticity and fluency. Studies have provided evidence that students are not handwriting very well and that more than half of students are not handwriting quickly enough to keep up with the demands of the classroom (e.g., Graham et al., 2008). Furthermore it has been evidenced that those who do not learn how to properly form letters early will struggle to unlearn these mistakes later on (Graham 1992). Given the crucial connection between learning basic handwriting skills and future composition ability (Alston & Taylor, 1987; Graham et al., 1997; Mather & Roberts, 1995), it cannot be understated how important it is for curricula to contain outcomes that focus on receiving instruction within the areas of proper paper positioning and proper pencil grip; letter recognition and letter formation; and to develop automaticity and fluency in their handwriting so that deficiencies within these areas are not progressively more detrimental to students.

A variety of effective techniques to support teaching these content areas are described in the research (see Chapter 2), and it is strongly recommended that information about these techniques be made available to teachers. The importance of making this information available to teachers is supported by Graham et al. (2008) who found that teachers in grades primary to three did not have a solid understanding of effective handwriting teaching practices. Neither the new Language Arts curriculum (NSDEECD, 2015a) nor the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document offers support for teachers in how to teach proper paper positioning and proper pencil grip; how to recognize letters and form letters; and how to develop automaticity and fluency in handwriting. Having these methods structured in a document that is easily accessible to teachers would be of benefit to both teachers as well as their students.

Recommendations for Future Teacher Documents. Currently, it is necessary to view curricular outcomes from the new Language Arts curriculum (NSDEECD, 2015a) and then search for effective teaching strategies to teach these outcomes from another document such as the Teaching in Action, Grades Primary-3, (Nova Scotia Department of Education, 2006). The fact that this information that must be used together needs to be found in multiple places unnecessarily complicates the process of using the curriculum for teachers. Therefore, it is suggested that in future curricular publications, evidence-based practices with respect to learning handwriting be combined with curriculum based content outcomes within a single document that teachers can refer to more easily.

Finally, this combined document should also place emphasis on including evidence-based handwriting instruction for students beginning in grade primary. This will maximize children's writing development, minimize the number of children who struggle with handwriting due to poor instruction, and help identify students with difficulties that are not due to poor instruction (Graham et al, 2001).

Recommendations for Teachers

It is evident that the new Language Arts curriculum (NSDEECD, 2015a) and supportive documents such as the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006) document have several shortcomings that can have implications for both pre-service teachers and in-service teachers. These documents only emphasize teaching written composition and completely omit mention of instruction in developing beginning handwriting skills which are crucial to the development of strong written composition skills. With this emphasis on written composition, pre-service teachers may understandably underestimate the importance of focusing on beginning handwriting skills. Therefore Bachelor of Education

programs might need to place more emphasis on teaching pre-service teachers about the importance of developing handwriting skills and the evidence-based practices that support these teachings. Research supports the importance of including specific training about teaching handwriting in Bachelor of Education programs. Phelps and Stempel (1989) found that teachers do not receive strong training in teaching handwriting, and Graham et al. (2008) noted that teachers had mistaken beliefs about what they believed to be effective handwriting instruction.

It may also be helpful to pre-service teachers for Bachelor of Education programs to include discussion of evidence-based findings about handwriting instruction from research. One example of an important finding that would support pre-service teachers' development of an understanding of the importance of handwriting instruction is that the level of automaticity and fluency in handwriting that a student has attained, is highly related to how well they later perform with written composition (Medwell & Wray, 2014; Wicki et al., 2014). Another example would be the Peverly et al. (2014) study which found that the lower level tasks of planning and motor movements consume valuable cognitive energy that strains working memory and negatively affects a person's ability to produce longer pieces of written composition. Pre-service teachers may also benefit from being exposed to literature which links handwriting practice to the ability to recognize letters of the alphabet (James & Engelhardt, 2012; Longcamp et al., 2005) along with the neuroimaging evidence that shows activation of a brain area known to be involved in letter processing and reading when people engage in handwriting (Flowers et al., 2004; Garrett et al., 2000; Schlagger & McCandliss, 2007). If pre-service teachers are exposed to this information in their training it may help them to understand the importance of teaching handwriting as it relates to written composition and other areas of learning such as reading.

In-service teachers would also benefit from receiving information with regard to the importance of teaching handwriting. Again, this conclusion is supported by research which has found that teachers do not receive strong training in teaching handwriting (Phelps & Stempel, 1989) and that they often had mistaken beliefs about effective handwriting instruction (Graham et al., 2008). This information may best be relayed through workshops or presentations conducted in schools or at the school board level.

Anecdotally, however, there is evidence to suggest that some school boards are placing more emphasis on developing handwriting skills despite the limitations of current teaching documents. For instance, Handwriting Without Tears (Olsen, 2008) is one handwriting program that is being used in some areas and could be promoted more for use in additional schools. Other evidence-based resources are easily available. One example is Graham and Harris' (2000) handwriting program which provides evidence-based practices across handwriting content areas specifically for grade one and is available for free online. Furthermore, both pre-service and in-service teachers could be provided with knowledge about the usefulness of administering an alphabet or copy task to students periodically and its importance in monitoring students' progress toward becoming automatic and fluent writers (Alston & Taylor, 1987; Datchuk & Kubina, 2012; Graham, 2010).

Implications for School Psychologists

The lack of emphasis on teaching handwriting in the new Language Arts curriculum (NSDEECD, 2015a) also has implications for the practice of school psychologists. Specifically, school psychologists are faced with challenges within the areas of assessment, diagnosis, and the recommendations that they provide for students struggling with handwriting.

Assessment and Diagnosis. School psychologists in Nova Scotia currently use the Learning Disabilities Association of Canada (LDAC) definition when assessing for learning disabilities. Difficulty with writing (and handwriting) could be one reason why a student would be referred by school personnel for a psycho-educational assessment. An important component of the diagnostic criteria for learning disabilities is the requirement that an academic weakness (e.g., poor handwriting and/or writing skills) cannot be primarily due to what LDAC terms ineffective (or lack of) teaching (LDAC, 2003). Given that poor handwriting is related to poor overall academic performance (Alston & Taylor, 1997; Mather & Roberts, 1995) and that poor handwriting skills are related to poor written composition skills (Graham et al., 1997), and that teachers may be unprepared to teach handwriting effectively (Graham et al., 2008; Phelps & Stempel, 1989), it might be hard for school psychologists to know whether students with handwriting and/or written composition difficulties have had sufficient handwriting instruction. The extent to which instruction has been provided must be explored; because it would be inappropriate to diagnose a learning disability when the cause of poor performance in an academic area is that a student has not had sufficient opportunity to learn.

Perhaps for this reason it is recommended, on the suggestion of Berninger and Wagner (2008), that school psychologists directly observe students during instruction and interview teachers about the curriculum and teachers' accompanying teaching methods. Furthermore, it may be helpful or even necessary for school psychologists to interview previous teachers of a student who is being assessed for handwriting or writing difficulties since various studies have highlighted the impact of not implementing evidence-based instruction in handwriting in kindergarten and grade one (Graham, 1992; Graham et al., 2001; Vander Hart et al., 2010).

The tools which are used by school psychologists may also need to be taken into consideration when there is uncertainty of prior instruction received by a student. One of the most common tools used in a psycho-educational assessment when handwriting or writing difficulties are being investigated is the Beery-Buktenica Developmental Test of Visual-Motor Integration (VMI; Beery, 2006). Research is supportive of the relationship between performance on the VMI and handwriting legibility and speed in students in grades one to nine (Cornhill & Case-Smith, 1996; Tseng & Murray, 1994; Weintraub & Graham, 2000). Other research has found that the ability to copy the first nine forms of the VMI demonstrates that a student is ready for formal instruction in writing (Benbow, Hanft, & Marsh, 1992; Weil & Amundson, 1994). These first nine forms include a vertical line, horizontal line, circle, cross, square, left diagonal line, right diagonal line, triangle, and an X (Beery, 2006). What is important for school psychologists to investigate is whether poor performance on this assessment protocol is due to a cognitive processing deficit (generally the assumption) or due to the student not having had sufficient teaching and practice with handwriting. The same difficulties arise when using other standardized tools such as the Process Assessment of the Learner – Second Edition: Diagnostics for Reading and Writing (PAL II; Berninger, 2007) which includes an alphabet writing task. Such challenges for school psychologists further highlight the importance of interviewing current and previous teachers of a student of concern and of using direct observation of students during instruction in addition to administering these standardized measures.

Implications for School Psychologist Report Recommendations. The benefits of developing handwriting skills are clear from the literature, with possible links to higher levels of processing (Muller & Oppenheimer, 2014) and possible links to letter recognition and reading (James & Engelhardt, 2012; Longcamp et al., 2005). Such gains are not typically seen with

keyboarding instruction (Longcamp et al., 2005; Mueller & Oppenheimer, 2014). Yet, it is recognized that keyboarding skills play an important role in society at the present and in the future; however, research is less conclusive about the best time to begin keyboarding instruction. Berninger and Richards (2002) advocated for instruction in keyboarding by the first grade, but others have suggested later elementary (Freeman, MacKinnon, & Miller, 2005). The lack of conclusive research on optimal grades for keyboarding instruction leaves the school psychologist without a firm reference point to make recommendations about keyboarding as either an adaptation or accommodation for individuals who struggle with handwriting.

A common recommendation for students who have handwriting difficulties is that they be able to use a computer when they write (Freeman, MacKinnon, & Miller, 2005). Allowing an individual who struggles with handwriting to use a computer does not necessarily result in faster writing or in the production of more written work (Berninger et al., 2009). Berninger et al. (2009) highlighted that without providing explicit instruction in keyboarding and the writing process using this tool, a computer may not be a useful strategy for working around transcription problems. School psychologists will be faced with deciding whether to recommend that students be explicitly taught using evidence-based techniques in keyboarding or to advocate that a student receive more intervention and practice developing handwriting skills using the same techniques that may not have been provided initially. Based on the fact that handwriting instruction is not currently included in the new Language Arts curriculum (NSDEECD, 2015a), school psychologists in Nova Scotia should strongly consider initially recommending more support to develop handwriting skills.

Limitations and Future Research

The current manuscript focused on handwriting outcomes and teaching methods recommended in the new Language Arts curriculum in Nova Scotia and accessible supporting teaching documents. A limitation of this manuscript is that the exploration of the curriculum was limited to the content of the new Language Arts curriculum (NSDEECD, 2015a) and supportive documents such as the Teaching in Action, Grades Primary-3 (Nova Scotia Department of Education, 2006). Discussions with educational personnel to determine what handwriting practices they implement (i.e., how the curriculum is implemented in classrooms), could be explored within Nova Scotia schools and could help in obtaining further knowledge of supporting resources that may or may not be needed.

Future research could explore the status of evidence-based handwriting instruction in other provinces through an examination of relevant provincial curriculum documents. Future research could also focus on the role of keyboarding, including determining a preferred time to offer instruction to students in keyboarding so as not to impede their handwriting development. School psychologists could also be surveyed to determine which assessment measures they prefer to use for the assessment of handwriting and to gather information with respect to the difficulties that they might experience when assessing children who struggle with handwriting. Lastly, more research with teachers to determine their views with respect to focusing on the teaching of handwriting skills to students would be of benefit to the literature and to inform teacher training and teaching practices.

Conclusion

The potential cognitive and academic benefits of learning to handwrite shows that handwriting is still an important skill that is worthy of significant attention in schools today.

More widespread promotion and awareness of the positive implications that learning to handwrite have on students is important in reversing the current trend (easily detected in the current Nova Scotia Language Arts curriculum) to de-emphasizing teaching handwriting skills. While keyboarding skills are also valuable to learn, it is important that a focus on this skill does not take the place of evidence-based teaching in handwriting. Administrators, teachers, and other educational professionals need to be mindful of the limitations currently displayed by the Nova Scotia Language Arts curriculum within the area of teaching handwriting and the possible consequences that this might have for the development of written composition and other academic areas.

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