Assessing the Pedagogical Practices of Print Path® Handwriting Curriculum:

A Literature Review

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Abstract

Research has found that the ability to write legibly and automatically by hand is critical to the development of literacy skills and that when handwriting is taught gains in written language expression are seen. This paper searches for the best teaching practices that have been discovered through research in various fields of study including psychology, education, special education, motor learning, and occupational therapy. An essential missing component of both traditional and contemporary handwriting instructional strategies is brought to light and utilized in a new handwriting approach. The Print Path® handwriting curriculum (Triggs, 2012) adheres to the findings of movement theory, utilizes the zone of proximal development and a multitude of other effective teaching techniques bringing these together in a way that is effective, engaging to children, and easy for teachers to implement.
Assessing the Pedagogical Practices of Print Path® Handwriting Curriculum:

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Over the past three decades, research has consistently and substantially documented the critical and fundamental role of handwriting in children’s and adult’s abilities to communicate in written form. Multiple studies have identified handwriting as the single most critical factor in the quality and quantity of written composition throughout the K-12 experience (Christensen, 2009; Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Jones & Christensen, 1999; Medwell, Strand, & Wray, 2007; Medwell, Strand, & Wray, 2009; Medwell, & Wray, 2013; Puranik & AlOtaiba, 2012) and into college and adult life (Connelly, Campbell, MacLean, & Barnes, 2006; Connelly, Dockrell, & Barnett, 2005). Concurrently, interventions that lead to improvements in handwriting also lead to improvements in written language (Christensen, 2005; Jones & Christensen, 1999). In fact, it has been found that interventions addressing handwriting are more effective in improving compositional fluency than those addressing phonological awareness (Graham, Harris & Fink, 2000).

Prominent cognitive psychologists James and Engelhardt (2012) conducted research on the neural activity of five-year-old children using magnetic resonance imaging (MRI) and found that learning to print goes beyond impact to the motor cortex and impacts areas of the brain associated with language and reading. James and Engelhardt found that the areas of the brain responsible for reading were activated only after children had previous experience with handwriting and not typing. They conclude that the act of learning to print letters aids in the acquisition of letter identification and reading skills. As numerous researchers have documented the importance of handwriting skills and have shown printing to be a vital component of
language arts instruction, it is essential that effective and efficient pedagogical methodologies be implemented in today’s classrooms for the purposes of teaching printing skills.

Given that handwriting is such a pivotal academic and life ability, it is most distressing that only 19% of teachers look forward to teaching handwriting and 80% say that they have had inadequate preparation to teach handwriting (Gram & Harris, 2005). As an occupational therapist with 20 years school district experience, I have witnessed multiple, pervasive uses of ineffective methods and approaches to teach handwriting. It has been my professional responsibility to provide services inside regular education classrooms to children who struggle with movement learning. It is very difficult to impact the motor learning of letter formations with children who struggle, when they are not provided with quality explicit instruction. It is particularly difficult when the child who struggles attempts to avoid corrective interactions with the teacher who is trying to help them. Teacher’s corrections that are provided to students when the entire class fills out handwriting worksheets are ineffective, in part, as large group practice is the most humiliating format for children in which to receive teacher feedback. My observation is that when the entire class fills out printing worksheets, individual children, especially those who struggle most with writing, are resistant to receiving motor and verbal feedback. When children are not able to receive teacher feedback, instruction is not effective.

When handwriting instruction is ineffective, children acquire letter formation habits that are incorrect. It has been found by a number of investigators and it is my own experience that in children who are otherwise typically developing, if incorrect illegible formations go on uncorrected during a child’s elementary years, the result can be long term illegible handwriting due to disordered letter formations, letter shape distortions, and extra strokes (Asher, 2006; Sheffield, 1996). As children mature beyond first grade and their handwriting speed increases,
incorrect formations result in illegibility. If formations are started incorrectly at the bottom of a letter, if curves are made with clockwise instead of counterclockwise motions, or if extra strokes are added, future legibility will be compromised. In these cases illegibility is not due to a student’s disability, but to inattentive, incomplete, and inadequate instruction on the part of a teacher. Figure 1 includes samples from my own practice. Here we see the illegible handwriting samples of a child with typically developing fine motor, visual motor, and sensory systems. This fourth grade child does not have any disability that an occupational therapist would typically treat, but their handwriting is profoundly illegible and dysfunctional.
On the left side of Figure 1, individual letter formations are shown. The reader is asked to determine what letter he is reading. Then the reader follows the arrow to the right, where the letter formations are shown within the context of a word. These illegible letter formations are a visual sample of ineffective printing habits that usually results in a multitude of lifelong difficulties. Unfortunately, this type of “disability” often stems from inadequate instruction. This type of preventable problem is what motivates me to bring quality handwriting instruction
to kindergarten and first grade students at this critical stage in children’s lives so they develop legible and automatic printing skills.

As a school-based occupational therapist, I have spent over 20 years of my career endeavoring to develop methods to effectively teach handwriting skills to all children in classrooms. Techniques that are very effective in one-to-one therapy sessions are not available to teachers not only due to their different training but because by definition teachers are responsible for 20 children at a time, not one. Addressing both of these issues, what has evolved is a multisensory station based curriculum. This curriculum, Print Path® (Triggs, 2012) uses techniques that simplify and scaffold learning, materials that are inviting and interesting to children, a fast pace of movement with small transitions to keep children engaged, and a scope and sequence of instruction so that teachers can use the most effective therapeutic practices on a classroom basis. Prior to 2012, this curriculum was used only in the classrooms and schools with teachers with whom I collaborated. Then in July of 2012 the literacy and instruction department of the urban Wisconsin school district where I am employed, decided to discontinue its previous ineffective and inconsistent methods for teaching handwriting and adopted the Print Path® handwriting curriculum to be used in all 30 schools and in over 270 kindergarten and first grade classrooms.

This literature review addresses these questions: What are the best instructional practices for teaching handwriting that are substantiated by research? Do these instructional practices align with the Print Path® (Triggs, 2012) curriculum? The following literature review is structured to examine these five critical pedagogical components of handwriting instruction:

1. Sequence. Evidence concerning the optimal order and timing of the introduction of alphabet case and individual letter formations.
2. **Scope.** The methods of explicit instruction that have been found to be the most effective to teach handwriting.

3. **Station based multisensory instruction.** The benefits of multiple transitions and the use of multisensory methods to teach printing skills.

4. **Small group Teacher supported practice.** Origins and application of the use of zone of proximal development. Use of effective feedback and application of the theory of motor learning for handwriting instruction. The effectiveness of teaching printing when feedback and motor learning principles are used compared to traditional handwriting instruction.

5. **Progress monitoring.** Investigation of a handwriting assessment tool that is highly aligned with written language skills that could be easily utilized by teachers as a formative assessment tool.

In pursuit of information to conduct this literature review, a wide and comprehensive search of academically based research literature was made in the area of handwriting. Searches were also made in several areas that relate to the acquisition of learning to print such as motor learning, the use of effective feedback, and best practices in education. Disciplines included education, learning disabilities, psychology, cognitive psychology, motor learning, and occupational therapy. While teaching and learning issues that are relevant within the United States are emphasized, worldwide research and data on handwriting was included. Books and edited chapters in books were included only if authors were considered to be prominent in their fields. Authors are judged to be prominent if they have conducted multiple studies or publications and are often cited by their peers.
Are Practices Utilized in Print Path® Handwriting Curriculum Corroborated in Research-Based Literature?

Considering the careful watch on high-stakes testing by professional educators and widespread adoption of Common Core States Standards (CCSS), it is more important than ever that teachers build instruction using evidenced based practices. This review of the literature examines specific components of the Print Path® handwriting curriculum (Triggs, 2012) that are substantiated and refuted by relevant research. Curricular components including letter order, explicit instruction, station-based multisensory experiences, small group teacher-supported practice, and progress-monitor tools will be analyzed by a careful review of relevant literature.

**Sequence**

Educational curricula must consider the sequence of instruction. It is important to consider the order and timing of the introduction of letters and words when teaching printing. Depending upon the perspective of the curriculum developer or teacher, printing can be taught using a variety of sequences.

**Teaching uppercase letters before lowercase.** The instructional practice of teaching capital letters first affords kindergarten children several advantages. Teaching uppercase first allows students to learn a system of writing that they can utilize when they are first asked to put their ideas on paper. Uppercase letters use simple forms, lines and curves, which are developmentally more appropriate and accessible to 5-year-old children (Beery & Beery, 2010; Olsen, 2012). The more complex lowercase letters, which re-trace and shift directions, are sized differently, and put in differing spatial locations, are impossible for many beginning kindergarten children to execute. No matter how excellent the instruction, not all kindergarteners have the underlying spatial temporal perceptions or visual motor skills to support this learning (Benbow,
Hanft, & Marsh, 1992; Beery & Beery, 2010; Daly, Kelley, & Krauss 2003; Marr, Windsor, & Cermak, 2001). Teaching uppercase before lower affords the younger children the time they need to develop critical perceptual-motor concepts. Teaching capitals first teaches all kindergarteners the essential top-to-bottom stroke and builds confidence that they can learn to print (Taras, Brennan, Gilbert, & Reed, 2011).

Kindergarten children are asked to put letter and word sounds down on paper as soon as they enter school; if we validate their uppercase efforts and prevent them from failing in their first attempts, we thwart three major problems. One, we can prevent diminished self-esteem and loss of self-efficacy (Feder, & Majnemer, 2007; Mather & Roberts, 1997; Sassoon, 2003). Two, we can prevent the phenomenon of writers who self-identify as not able and therefore avoid writing (Graham & Harris, 2006). Three, when giving kindergarten children an opportunity to use uppercase in their daily writing, we prevent practicing of errors and problems of lifelong illegibility (Schmidt & Lee, 2011). Graham (1992; 2006) describes the difficult task teachers have in supporting children to un-learn incorrect and inefficient motor habits. It is the practicing of errors (i.e., incorrect motor learning) that adds to the child’s and teacher’s workload.

**Letter groups that are based on similar formations.** When students are introduced to letter formations using a letter sequence based on the instruction of phonics, or class subject units (Simner, 2003) teachers may move through the alphabet in a non-sequential way. On the other hand when handwriting is taught as a separate skill, individual teachers may use a standard alphabetical sequence i.e., Aa, Bb, Cc to Zz. But an entirely different sequence is used in curricula that have been professionally developed to teach handwriting. When a printing curriculum is developed using methodologies of task analysis, motor learning, scaffolding, and developmental sequence, we find that letters are grouped by similar formation. The learning of
the skills associated with one letter builds directly on the skills that were gained while learning the previous letter (e.g. *Handwriting Without Tears*®, Olsen, 2012; *Loops & other Groups*, Benbow, 1999; Benbow 2006; *Sassoon’s*, Sassoon, 2003; *Write Direction*, Taras et al., 2011). Even contemporary versions of *Zaner-Bloser* (originally published in 1904) which presents letters using a capital lowercase pairing, does so in a sequence with attention to the lowercase formation. That is, o, a, d, and c are grouped together but taught in the sequence of Oo, Aa, Dd, Cc, (Zaner-Bloser, 2008). Several studies and handwriting authorities have corroborated the effectiveness of handwriting interventions in improving handwriting when similarly formed letters are taught together, (Denton, Cope, & Moser, 2006; Gentry, & Graham, 2010; Graham, 1992; Graham & Harris, 2005; Jones, 2004; Kaiser, Albert, & Doudin, 2011; Schlagal, 2013; Taras et al., 2011; Troia & Graham, 2003).

**Print Path® Sequence.** Teaching handwriting from a developmental and motor learning perspective, Print Path® (Triggs, 2012) considers the differences between uppercase versus lowercase formations and the differences in path of movement with both cases. Capitals are taught to kindergarten children near the beginning of the year and are practiced three times weekly for a total of 70 minutes per week and for 8 weeks (see Appendix A). At the first grade level it is recommended that teachers spend two weeks reviewing capitals (see Appendix B). The teaching of capitals first gives children the opportunity to practice and learn the motor memory of starting letters at the top and the experience of constructing letters with four simple shapes of big and little lines, or big and little curves. Both the capital and lowercase provide letter groupings that are formed similarly; similar letters are grouped together so that a child’s previous motor learning of a simple letter can be used to learn the more complex movement of the next letters. For example, when a child is learning lowercase ‘c’ they have already learned
the capital c and that it is made with a simple curve. After learning lowercase c and o, they are taught how the letter c is the beginning of the letters a, d, g, q and s in the ‘c starts’ group.

Scope

Whole group instruction is central to providing explicit instruction. It is here that the teacher has the eyes, ears, minds and hands of every student. What is done with this time and opportunity is critical. But, what does research tell us are the best practices? The cognitive strategies developed through research by psychologists and learning disability specialists are well suited to use during whole group instruction. Research has documented substantial improvements in skills using the following methods of instruction.

- Live modeling and motor imitation: The teacher slowly demonstrates how each letter is formed, including where it starts in relationship to the top-middle-writing lines. Students are asked to use their writing fingers, extended index finger of their dominant hand, to air write letters as the teacher forms them (Case-Smith, Holland, & Bishop, 2011; Christensen, 2009; Graham & Harris, 2006; Jones & Christensen, 1999; LaNunziata, Cooper, Hill & Trap-Porter, 1985; Schlagal, 2013; Taras et al., 2011; Troia & Graham, 2003; Vander Hart, Fitzpatrick, & Cortesa, 2010).

- Verbal repetition of movement patterns: The class is invited to repeat path of movement language for the formation as the teacher forms the letter and they are air writing (Case-Smith et al., 2011; Graham and Harris, 2006; Schlagal, 2013; Troia & Graham, 2003; Vander Hart et al., 2010).

- Singing: Songs and chants are culturally relevant and developmentally appropriate methods to teach and reinforce a multitude of concepts and skills (Let's Sing About It!, 2004; Hollie, 2011; Olsen, 2012; Taras et al., 2011; Schlagal, 2013; Trafford & Nelson,
The Handwriting Without Tears curriculum teaches optimal pencil grip by use of “The Crayon Song” which cues students to attend to the position and placement of all 5 fingers (Olsen, 2012).

- **Modeling of self-evaluation:** The teacher models common mistakes made with a particular formation and calls on students to articulate the error that was made. During whole group instruction the teacher can review for the class his/her formations, circling the best one and crossing out the incorrect ones (Graham & Harris, 2006; Troia & Graham, 2003).

- **Whole group verbal responses:** Integrating letter formation with letter name is effectively accomplished during whole group instruction (Graham & Harris 2005; Schlagal, 2013; Vander Hart et al., 2010).

**Print Path® Scope.** Kindergarten and first grade teachers are instructed in teaching 11 Print Path® (Triggs, 2012) scope elements (see Appendix C) during a two-hour professional development session that is led by trained school district occupational therapists. Teachers are instructed through the use of handouts, visual representations, pictures, demonstrations, and short videos showing actual classroom teaching. The best practices of live modeling and motor imitation, verbal repetition of movement patterns, modeling of self-evaluation, and whole group verbal responses are illustrated. Additionally scope elements including techniques to explicitly teach children consistent use of names of the three paper lines, the three ‘short-tall-tall’ sizes of letters, and the three spaces that all letters are placed are demonstrated. The Print Path® curriculum specifically uses three songs for the purposes of instruction (see Appendix D). Top to bottom formations are taught by singing “If you want to write a letter start at the top” sung to the familiar tune of “If you are happy and you know it”. Optimal pencil grip is taught by use of
“The Crayon Song” (Olsen 2012). The quick and efficient visualization of the size of letters that is necessary for automatic letter writing is accomplished by having children assume “short” “tall” and “tail” body positions as they sing their “a, b, c’s”.

Station Based, Multi Sensory Instruction

In a national survey Graham et al. (2008) revealed that the vast majority of teachers, 97%, rely upon whole group instruction and whole class practice on penmanship sheets. Of the 169 respondents, a majority of 61% use a commercial curriculum and only 5% ever report using small group instruction. This literature review goes on to explore what research reveals concerning the benefits to student outcomes when instruction utilizes small group stations to implement multisensory interventions.

Stations. Stations provide students with a variety of materials, which affords ways of maintaining the students’ attention and effort. Using stations, sometime called centers, within the classroom is important for handwriting instruction as children need to stay engaged to execute the same formation-motion, and have adequate repetitions of the movement in order to afford adequate motor learning (Poole, 1991). In addition to providing multiple sensory inputs the movement between stations is helpful. Many authors have written about the benefits to students’ level of energy and engagement when pacing and movement opportunities are incorporated throughout the instructional day (Cohen & Goldsmith, 2003; Hollie, 2011; Marzano, Pickering, & Heflebower, 2011). Another benefit of the station-based learning is that it offers the opportunity for peer-to-peer feedback. This can happen informally or formally by teacher discretion. Hattie and Gan’s (2011) meta analysis of research finds peer feedback as one of several forms of relevant and effective feedback. At these non-supervised stations students have the opportunity to take responsibility, assist friends, interact around the day’s lesson, and
take ownership of their own learning. As far as this author knows there are no commercial or published handwriting curriculums that use stations that children rotate through during a handwriting instructional period as is used in the Print Path® curriculum.

**Multi Sensory.** What do researchers conclude about using multisensory approaches to teach handwriting? Zwicker and Hadwin (2009) looked at the effects on legibility using undescribed multisensory interventions versus using a cognitive approach. They found that the use of a multisensory approach had greatest change in legibility at first grade and cognitive interventions had the greatest change at second grade. As Zwicker and Hadwin did not describe the specific multisensory interventions used, their results are impossible to compare to other curriculums that utilize multisensory strategies. Case-Smith et al. (2011) used a core curriculum approach including stations, cognitive strategies, and multisensory approaches. They looked at the legibility of handwriting by first grade students before, after, and six months following a 12 week period of instruction. They found significant improvements in handwriting legibility and speed, as well as compositional fluency, which were maintained when first grade children were tested six months after the curriculum was completed.

Do commercial curricula use multisensory strategies? The commercial curriculum, Loops and Other Groups (1999) originally published in 1990, was developed by a prominent occupational therapist, Mary Benbow, who was a pioneer in the teaching of handwriting. Benbow was at the forefront of teaching through the use of multisensory letter experiences and was revolutionary in her emphasis on the use of kinesthetic feedback and motor memory to learn the formation of letters. Her pedagogical innovations have been widely used by occupational therapists and have added significantly to the understanding of the teaching of handwriting. Unfortunately, Loops and Other Groups is limited to cursive workbooks and Benbow’s work is
written for the application of occupational therapists rather than by teachers. There are no curriculum instructional materials such as scope elements to assist teachers in the application of her theoretical work such as kinesthetic feedback and motor memory. Neither teachers nor therapists are given tools needed to teach when they are faced with a classroom of students.

Handwriting Without Tears®, (HWT) developed by occupational therapist Jan Olsen, was originally published in 1998. HWT promotes multisensory instruction through the use of many innovative and inviting objects. Unfortunately, the cost of these objects when supplied to an entire classroom is significant and this author has observed that many elementary teachers use only the workbooks and terminology and not the multisensory strategies. Another aspect of the HWT curriculum is that the multisensory materials apply mostly to learning of capital letters, and are therefore are not appropriate to use with kindergarten and first grade students when they are learning to form lowercase letters. Still another limitation with HWT is its high reliance on copying. In fact Jones (2004) points out that one of the limitations of all commercial curricula is that they typically offer only opportunities for skills of copying and tracing. The important modality of kinesthetic input without a model that builds visual memory is absent.

Print Path’s® Station Based, Multi Sensory Instruction. As far as this author knows there are no commercial or published handwriting curriculums that use stations that children rotate through during a single handwriting instructional period as is used in the Print Path® (Triggs, 2012) curriculum. With its use of sensory-based small group stations, Print Path® resolves the aforementioned limitations of Loops and Other Groups (Benbow, 1999). The Print Path® curriculum gives teachers what they need to provide printing instruction by including necessary materials and providing specific suggestions for three multisensory stations every time that handwriting is taught, three times per week for 20 weeks (see Appendix A). Teachers need
not understand concepts of visual perception or kinesthetic feedback (Benbow, 2006) and are able to implement the program with materials that are provided.

The problems of HWT (Olsen, 2012) which sells multisensory materials at costs prohibitive for most teachers or school districts to provide to each child, is solved by Print Path® through the use of small group station rotations. If using the HWT model, the teacher would need 20 items for a class with 20 students, but with the Print Path® she would only need to have 5. If a HWT teacher wanted to provide her students with 3 multisensory options, she would purchase 60 items, but as small groups of five students use materials the entire class of 20 students could have 3 multisensory options with a total of 15 class multisensory items. Additionally, as another example, instead of buying a magnet board for each child that can only be used with uppercase, Print Path® uses a magnet board with stylus appropriate for both upper and lowercase. Print Path® curriculum encourages the removal of visual models and blank line cards so that teachers can differentiate curriculum and children gain visual memory of formations as is needed for automaticity skills as they are ready.

Print Path’s® (Triggs, 2012) use of station rotations means that there are at least five transitions during a 20 to 30 minute instructional period. When first introduced to Print Path®, teachers sometimes ask, “Can I modify the number of stations so that there are fewer transitions”? Hollie (2011) discusses how certain teachers may be reluctant to let students work in small groups if there are not adequate strategies to regain attention. Hollie gives specific strategies for, and examples of effective and culturally relevant attention getting strategies in his book, Culturally and Linguistically Responsive Teaching and Learning (2011). Having effective attention getting strategies is essential when transitioning a classroom of twenty 5 and 6-year-old children at least five times during a 20 to 30 minute instructional period. During the Print Path®
professional development and on the Station Placement and Station Rotation video, optional transition strategies are demonstrated (Triggs, 2013). During the Print Path® PD it is suggested that teachers utilize their own attention getting strategies whether they are Yoga poses, clapping patterns, and call and response interactions, or simply asking children to point to their next station.

Print Path’s® use of multisensory materials and strategies are accomplished via five-minute station rotations (Triggs, 2013). The class is divided into four groups that all get the opportunity to practice target letters, words, or sentences at all three independent multisensory stations and one teacher supported station. While one quarter of the class sits with the teacher, the other three groups might be practicing formations or hand skills at teacher selected stations to include:

- Tracing over translucent gel bags on top of large letters. Starting point is indicated by a green “go dot”.
- Standing at the chalk or the classroom white board to practice target letters at the kindergarten level and target words at the first grade level.
- Construction of letters using big lines, little lines, big curves, and little curves, made from precut foam puzzle pieces. Students construct letters by fitting these foam pieces onto letter puzzle cards at the kindergarten level and onto blank lined cards at the first grade level.
- Tracing of letters in a pencil box that holds a thin layer of sand.
- Printing of letters on a board with use of a magnetic stylus.
- Use of i-Pad apps that use a font that corresponds with Print Path®.
• Punching out target letters and words in paper with a pushpin. Paper is laid on top of a sheet of soft foam.

• Writing letters with a string on a Velcro board using an author designed stylus.

Small Group - Teacher Supported Pencil Practice on Structured Practice Sheets

Russian psychologist Lev Vygotsky (1896–1934) described use of small groups to teach new material as the “zone of proximal development” (ZPD) in his landmark book Thought and Learning (2012, originally published in 1934). Piotr Gal’perin (1902–1988) brought ZPD to contemporary education (Haenen, 2000). Gal’perin researched the effectiveness of ZPD and used the motor skill of handwriting to demonstrate ZPD efficacy. His work continues to be used today, and as many as one third of all Dutch children learn handwriting based on Gal’perin’s experiments (Haenen, 2001).

In the United States small group instruction is commonplace in contemporary curricula that align with CCSS, and is utilized as a best practice for a multitude of subjects with a variety of ages; however, surprisingly, use of small group instruction is an extremely uncommon method for the teaching of handwriting (Asher, 2006; Denton et al., 2006; Jones & Christensen, 1999). Research from multiple academic disciplines support the effectiveness of using small groups to teach handwriting including feedback theory, motor learning theory, and studies that compare traditional handwriting instruction to instruction that incorporates small groups.

Use of feedback to optimize skill acquisition when students use a pencil to print in practice books. Small group instruction allows for feedback. Immediate and relevant feedback that provides students information on how they are doing at reaching a learning goal is the most effective among all researched educational practices as documented by multiple researchers and an over 800-mega analysis of research (Hattie & Gan, 2011). Within this mega analysis several
conditions were found that need to exist for feedback to be effective. Small group settings are ideal for providing students with feedback that meet Hattie and Gan’s criteria as the teacher is able to:

- consider how feedback is received by the student,
- make learning goals apparent to each student,
- focuses the student’s attention on the task rather than the student himself,
- differentiate the task in the moment in order to engage the student in the task at an equal level with or just above their current level of functioning.
- challenge the student to set and monitor his/her own learning goal.
- nurture a learning environment is suited to acceptance of errors and the disconfirmation of attempts.
- identify their own errors in instruction so that modifications can be made to improve teaching and learning.

*Use of theory of motor learning to teach printing.* Teachers generally use practices that are based on theories of education and psychology. Whereas Occupational and Physical Therapists often use practices that originate from the realm of movement theory (Guadagnoli, & Lee, 2004), motor learning principles are not widely known among most educators (Baker, 1999). Schmidt & Lee (2011, originally published in 1982) gives us a commonly accepted and often repeated definition of motor learning as “a set of processes associated with practice or experience leading to relatively permanent changes in the capabilities of responding” (p. 302). In other words when you practice or repeat a set of motions, these repeated motions create habitual patterns of behavior. This concept, that once a motion is learned it is relatively permanent, has a significant and pivotal impact on young ones who learn incorrect formations when writing. It
speaks to the importance of teaching letter formations correctly from the start. Giving kindergarten and first grade teachers the opportunity to work in small groups to prevent incorrect motor learning can prevent children making and cementing into their motor memory illegible letter formations.

**Traditional handwriting instruction.** A limitation with the majority of research done to discern best-practices to teach handwriting is that the research is done by a handwriting specialist using small group interventions rather than done within whole classrooms and by regular education teachers. By far the most common instructional method in the United States is for teachers to give handwriting worksheets to the entire class (Troia & Graham, 2003). If a teacher monitors the formational aspects of children’s printing, such as where a child starts a letter, or the direction they move the pencil on the paper, the teacher can only do so by walking from desk to desk and allows for only a few children to receive motor or verbal feedback. One question that remains is what are the effects of quality handwriting instruction when classroom teachers deliver instruction?

Comparing a model of traditional classroom based handwriting instruction versus instruction based on several researched-based best practices, Jones and Christenson (2012) investigated the effects on kindergarteners’ quality of printing and quality of written composition under the following conditions. Fifteen classrooms of kindergarteners were instructed using traditional approaches such as lowercase letters introduced first, use of penmanship copybooks, as well as an emphasis on language experience and guided writing. Fifteen experimental classes were taught handwriting emphasizing correct formations and automaticity skills through student’s use of motor imitation of live modeling of letters, tracing letters with beginning spots indicated, use of multisensory materials, sufficient repetitions to gain automaticity, and teacher’s
monitoring of individual children’s letter formations. In these experimental classrooms effective feedback and formative assessment tools were used. Results of this study showed dramatic gains in the experimental group of mean handwriting skills measuring 5.2 standard deviations higher than the traditional group. Consistent with other studies, the authors found that by providing quality handwriting instruction, concurrent improvements in measures of writing language were seen. The experimental group’s growth measured 2.4 standard deviations higher than the traditional group at written tasks such as generating understandable and relevant sentences in response to a picture prompt. This study substantiated strong evidence for updated classroom-based handwriting instruction focusing on (a) specific methods of explicit instruction including live modeling; (b) multisensory materials including opportunities for tracing and sufficient repetitions to gain automaticity; (c) teacher feedback in a small group setting; and (d) teacher use of progress monitor tools. Next, Print Path’s® (Triggs, 2012) use of one progress monitor tool will be investigated.

**Print Path’s® use of Small Group- Teacher Supported Pencil Practice on Structured Practice Sheets.** The structure of the Print Path® (Triggs, 2012) curriculum with its’ three independent multisensory stations frees up the teacher to lead one-five minute small group, for each child in the classroom during a 20 minute instructional period. This small group teacher-led station is ideal for effective instruction. Returning to Hattie and Gan’s meta analysis (2011) we can specifically see how a small group allows for several feedback conditions to be met when teaching Print Path®, see Table 1.
Table 1

*Seven Critical Components of Effective Feedback Reflected in Print Path’s® Small Group Instruction*

<table>
<thead>
<tr>
<th>Meta Analysis, Hattie &amp; Gan (2011)</th>
<th>Print Path® (2012) Teacher Supported Station</th>
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<tbody>
<tr>
<td>• Productive feedback is a consideration of how it is received by the student.</td>
<td>• As the teacher is in a face-to-face situation she can consider and adjust feedback based on how it is received by the student.</td>
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<tr>
<td>• The teacher is able to make learning goals apparent to each student.</td>
<td>• The objectives of the day’s lesson are transparent.</td>
</tr>
<tr>
<td>• Powerful feedback focuses the student’s attention on the task rather than the student himself.</td>
<td>• When corrected by the teacher in the small group, rather than in a whole class setting, the learner focuses in on the task of writing rather than on himself and how he looks to the group.</td>
</tr>
<tr>
<td>• Feedback is designed to engage the student in the task at an equal level with or just above their current level of functioning.</td>
<td>• In the small group the teacher can modify the task and expectation to be at or just above the individual child’s level of skill. Differentiation is easily accomplished without need to plan or prepare separate materials.</td>
</tr>
<tr>
<td>• Feedback works to challenge the student to set and monitor his/her own learning goal.</td>
<td>• A skilled teacher has the opportunity to help individual students to set and monitor their personal handwriting goals.</td>
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<tr>
<td>• The learning environment is suited to acceptance of errors and the disconfirmation of attempts.</td>
<td>• The small group setting allows teachers to make students aware of their mistakes so that students are able to modify movement patterns.</td>
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<tr>
<td>• Feedback should help the teacher identify errors in instruction so that modifications can be made to improve teaching and learning.</td>
<td>• As the teacher has the opportunity to directly observe the responses to instruction, teachers can immediately rectify omissions and errors or modify teaching to improve their handwriting instruction.</td>
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With Print Path®, the structure of the curriculum allows teachers to give immediate and relevant feedback as they work with children in small groups. The curriculum utilizes one teacher-led table-station so that the teacher is able to provide verbal reinforcement or disconfirmation, specific feedback, the repeating of motor directions, or physical guidance to individual students as needed (Asher, 2006; Vander Hart et al., 2010). The teacher is afforded the opportunity to provide attention to and gentle individual guidance for, how the letter is made, not just the final product. This is critical in learning correct formations and future legibility (Jones, 2004). When children are in small groups they do not feel singled out in front of the entire class, and anxiety and shame do not interfere with risk taking, so their attention is on the task rather than self. Additionally students directly witness other children getting assistance and have a momentary break without the pressure of the teacher’s eyes when he/she is guiding another child in the group.

Progress Monitor Tools

Several studies previously cited use some variation of ALPM (Alphabet Letters Per Minute) as a measure of handwriting skills (Berninger, et al., 1997; Graham et al., 2000; Jones & Christensen, 1999; Medwell et al., 2007; Medwell, & Wray, 2013). This measure was originally devised by Berninger, Mizokawa, & Bragg (1991). Students are given one minute to write the lower case letters of the alphabet in sequence without a letter model. ALPM has subsequently been used by multiple researchers as it is the one measure that consistently best corresponds with automaticity of handwriting skills (Christensen, 2009; Connelly et al., 2005; Connelly et al., 2006; Berninger et al., 1997; Graham et al., 1997; Graham et al., 2000; Jones & Christensen, 1999; Medwell et al., 2007; Medwell et al., 2009; Medwell, & Wray, 2013; Puranik & AlOtaiba, 2012; Rosenblum, 2005). Automaticity skills, allowing for fast and automatic printing without
needing to look at an alphabet model, are critical to literacy skills because they allow writers to focus on what they want to write rather than how to write individual letters (Berninger, 2012; Christensen, 2009; Troia, & Graham, 2003). ALPM is impacted by, and indicates, student skills involving visual memory, alphabetic awareness, and speed of legible lowercase formations. As ALPM is a measure of visual memory and speed of formation rather than a measure of accuracy of formation it is appropriate for use at the first grade level for children who have already learned the basic movement path of each letter (Medwell and Wray, 2013).

Print Path® (Triggs, 2012) incorporates ALPM into the first grade curriculum (see Appendix E) after children have had the kindergarten year to learn to correctly form letters. Print Path® provides teachers and students prompts to practice use of writing one minute alphabets by use of “Alphabet race” sheets conveniently located in their handwriting practice books (see Appendix F). Additionally a graph to measure progress of ALPM is located on the back page of the practice book designed to engage and motivate students in monitoring of their own progress (see Appendix G).

**Implementation to Practice**

Quality handwriting instruction trains the brain and frees up cognitive resources that are needed for written language production. This literature review finds several specific and critical components of handwriting instruction from several relevant fields of study including psychology, cognitive psychology, education, special education, motor learning, and occupational therapy, which are found in the Print Path® (Triggs, 2012) curriculum. The critical pedagogical components embedded in Print Path® include:

- Teaching uppercase before lowercase and the grouping of letters by similar formation provides a developmentally appropriate and a scaffolding of sequence within handwriting
instruction. This author concludes that while we want to avoid counterproductive motor habits and thus avoid teaching 4 and 5-year-olds lowercase printing when they are not developmentally ready, we also should not limit kindergarten children’s writing. We should teach capital formations first, which will improve students’ abilities to express themselves in written form and thereby improve their early-standardized test scores.

- Effective scope elements incorporate strategies to include live modeling, motor imitation, modeling of self-evaluation skills, use of songs to learn key concepts, and whole group student responses including verbal rehearsal of path of movement language.

- Whether using commercial or teacher made curriculum, the vast majority of teachers rely upon whole group instruction and large group practice of printing on worksheets. But scholarly research reveals that this approach to handwriting instruction is less effective and fails to utilize highly successful components of station based multisensory experiences.

- The field of motor learning brings a perspective to teaching handwriting that has, thus far, been poorly addressed in traditional and contemporary handwriting instruction. Research from the field of motor learning indicates that legibility is not enough and that children must learn correct formations during the critical kindergarten year in order to establish fluid and fast movement patterns in first grade.

- Children need a proximal zone of instruction and effective feedback in order to learn correct formations, before formations are repeated in practice and to establish fluid and fast movement patterns. Feedback is critical to prevent the development of incorrect motor habits that lead to lifelong problems with legibility and automaticity skills and this is effectively delivered to students in small teacher led groups.

- Research confirms that automatic legible handwriting is more closely linked to the quality
and quantity of writing language composition then any other identified skill. ALPM is the one measure that most highly corresponds with printing and written language skills. Print Path® puts a quick and easy to administer ALPM assessment in the hands of teachers for use as a functional progress monitor tool. Through the use of “Alphabet Race” learning goals are transparent and students quickly come to understand that fast and legible writing is what is being taught, measured and expected.

Future research is needed to discern which multisensory strategies are the most effective. Additionally longitudinal and normative studies are needed to track children’s formations and the impact correct versus incorrect formations has on legibility and automaticity skills as they mature. It is only when we precisely know the normal course of development and the effects of instructional practices that we can know which interventions are the most appropriate and when children have reached proficient levels.

The instructional practices used in the Print Path® (Triggs, 2012) handwriting curriculum are corroborated by research from an extensive array of research originating from a variety of fields of study. These best practice instructional formats including sequence, scope, multisensory station experiences, small group teacher feedback, and use of a transparent progress monitor tool are brought together in Print Path®. Through the use of Print Path’s® station-based multisensory curriculum, kindergarten and first grade children are given the chance to progress in their education without being held up by slow or illegible handwriting. This researcher is diligently working in her schools district’s 30 elementary schools to help teachers to implement the Print Path® curriculum and to encourage use of progress measurement. This newly adopted handwriting curriculum addresses the need for effective evidence-based instruction to help prepare all children to be career and college ready.
References


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http://www.zaner-bloser.com/history


### Appendix A

Curriculum Maps; Upper and Lowercase, Kindergarten

#### Kindergarten Uppercase

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**Teacher selected scope & sequence elements and leads songs & activities. Situations are reviewed and modeled.**

1. Get bags & tracing sheets
2. Standing at chalk or white board
3. Big little & lines games: with puzzle sheets
4. Stand on right hand corner

**Situations**

**Teacher selected scope & sequence elements and leads songs & activities. Situations are reviewed and modeled.**

1. Get bags & tracing sheets
2. Standing at chalk or white board
3. Big little & lines games: with puzzle sheets
4. Practice books

**Situations**

### Kindergarten Lowercase

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**Teacher selected scope & sequence elements and leads songs & activities. Situations are reviewed and modeled.**

1. Get bags & tracing sheets
2. Standing at chalk or white board
3. Big little & lines games: with puzzle sheets
4. Stand on right hand corner

**Situations**

**Teacher selected scope & sequence elements and leads songs & activities. Situations are reviewed and modeled.**

1. Get bags & tracing sheets
2. Standing at chalk or white board
3. Big little & lines games: with puzzle sheets
4. Practice books & color

**Situations**
### Appendix B

**Curriculum Maps; Upper and Lowercase, First grade**

<table>
<thead>
<tr>
<th>First Grade Upper Case</th>
<th>Lowercase Letters</th>
<th>Tracing letters</th>
<th>First Grade Lower Case</th>
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**Upper Capital Letters**

- A: Teacher selects scope elements and leads song, activities. Stations are reviewed and modeled.
- B: Pelican story, 1.
- C: Sand or soft box
- D: Practice book (3 sets, without practice pages, build bility with index cards)
- E: Pelican story, 1.
- F: Sand or soft box
- G: Practice book (3 sets, without practice pages, build bility with index cards)
- H: Pelican story, 1.
- I: Sand or soft box
- J: Practice book (3 sets, without practice pages, build bility with index cards)
- K: Pelican story, 1.
- L: Sand or soft box
- M: Practice book (3 sets, without practice pages, build bility with index cards)
- N: Pelican story, 1.
- O: Sand or soft box
- P: Practice book (3 sets, without practice pages, build bility with index cards)
- Q: Pelican story, 1.
- R: Sand or soft box
- S: Practice book (3 sets, without practice pages, build bility with index cards)
- T: Pelican story, 1.
- U: Sand or soft box
- V: Practice book (3 sets, without practice pages, build bility with index cards)
- W: Pelican story, 1.
- X: Sand or soft box
- Y: Practice book (3 sets, without practice pages, build bility with index cards)
- Z: Pelican story, 1.
Appendix C

Eleven Scope Elements of Print Path®

Scope

1. Capitals: lines and curves
2. Base letters
3. Group names
4. Top to bottom
5. Verbal rehearsal
6. Imitation
7. Lines
8. Size
9. Space
10. Repetitions
11. Self-evaluation
Appendix D

Three Songs Used in Print Path®

If you want to write a letter start at the top
Tune ♪: If You're Happy and You Know It

If you want to write a letter start at the top,
♫ If you're happy and you know it. clap your hands ♫
If you want to write a letter start at the top,
♫ If you're happy and you know it. clap your hands ♫
If you want to write a letter, then you better, better, better
♫ If you're happy and you know it. then your face will surely show it
Remember to start it at the top!

HWT version “Where do you start your letters” http://www.youtube.com/watch?v=um096Twf3lQ

Crayon Song
Tune ♪: “Open and Shut Them”

Pick up a crayon, Pick up a crayon, This is easy to do
♫ open them shut them, open them shut them, put them in your lap ♫
Pick up a crayon, Pick up a crayon, I just tell my fingers what to do
♫ open them shut them, open them shut them, give a little clap ♫
My thumb is bent, Pointer points to the tip, Tall Man uses his side
♫ Creep them creep them Creep them creep them right up to your chin ♫
I tuck the last two fingers in, And take them for a ride
♫ Open up your little mouth But do not let them in

Pencil Grasp (Learn to pick up a pencil) http://www.youtube.com/watch?v=DP5htYZ5jjQ

Alphabet Song
Tune ♪: “abcdefg”

<table>
<thead>
<tr>
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<td>Tail</td>
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![Alphabet Song Images]
Appendix E

ALPM-1: Alphabet Letters Per Minute-First Grade

Administration Directions:

ALPM can be given to small groups or to the entire class.

“We are going to play a game that will show me how well and quickly you can write your little abc’s. You will write your lowercase, small abc’s, as fast and as carefully as you can. Don’t try to erase any of your mistakes, just cross them out, try again or just go on”.

Demonstrate printing a b c. Then demonstrate A, cross it out, and continue A a b c.

I will say “Get Ready, Get set,” and you can pick up your pencil. When I say “Go” you can start to write your lowercase, abc’s as fast and as carefully as you can. If you finish before I say stop, start a new alphabet. When one minute is up, I will say stop and you will put your pencils down, right away.”

Answer questions.

Model picking up your pencil as you say “Get Ready, Get set,” and putting it on the paper as you say “Go”.

After 60 seconds say “Stop, put your pencils down”.

Scoring:

Scores express the number of legible sequential letters written in one minute (ALPM).

Scores are calculated by counting letters that are recognizable out of the context from the rest of the writing. Omissions, reversals, uppercase, out of sequence, and substitutions do not count towards score. For example. (a B c D d f e h g) would be a score of 5 (a c d e g). Errors do not need to be crossed off. Formations do not need to be correct.
Appendix F

ALPM-1 Paper: Alphabet Letters Per Minute-First Grade

Get ready, get set, a→z, a→z,
Appendix G

ALPM-1 Motivational Chart: Alphabet Letters Per Minute-First Grade