

Evidence Topic: Which is the best handwriting program?

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Primary Reviewer

EBPX Team Members

- Tina Jones
- Dr. Catherine Candler

Evidence Question:

Specific area under investigation: Person, Intervention, Comparison, Outcome

What is the most efficient method of teaching handwriting to children with handwriting difficulties?

Question Background:

What real life situations inspired this question?

Handwriting problems are the most common reason behind the referral to school based occupational therapy. During a regular elementary school classroom fine motor task such as those in cutting, coloring, and especially in writing takes up between 30% and 60% of daily activities (Ratzon, Efrain, & Bart, 2007). According to one author the use of paper and pencil task during a school day rates at 3.7% of head start/preschool, 19.3 of kindergartners and 26% to 51% of the day for second, fourth and sixth graders (Marr & Dimeo, 2006). The handwriting process is a complex perceptual motor skill that includes a combination of visual motor coordination, motor planning, cognition, and perceptual skills along with tactile and kinesthetic sensitivities (Feder & Majnemer, 2007). There are many approaches to teaching handwriting interventions to children with handwriting difficulties that include the cognitive, multisensory, kinesthetic, sensorimotor, task oriented approaches, and therapeutic practice. The *sensorimotor approach* is based on the idea that by adding varying sensory experiences the child's nervous system may use the information efficiently and produce a satisfactory motor output (Weintraub, Yinon, Hirsch, & Parush, 2009). The *task oriented approach* however is based on the premise that the acquisition of handwriting requires direct instruction and practice in different tasks and environments (Weintraub, Yinon, Hirsch, & Parush, 2009). The *multisensory approach* is based on the sensorimotor model of practice which involves the use of sensory experiences, media, and instructional material. It is believed that by providing opportunities for various sensory input the child's nervous system may gain the information so to produce satisfactory motor output such as legible letters (Zwicker & Hadwin, 2009). The *cognitive approach* is based on learning theories that involves self instruction along with verbal mediation. This approach uses imitation, practice, self evaluation and feedback (Zwicker & Hadwin, 2009). The *kinesthetic approach* focuses on motor aspects with the reintroduction of the letter while explaining each form both visually and verbally, self instruction, random practice, and model review of stroke direction before practice (Roberts, Siever, & Mair, 2010). Lastly the *therapeutic practice approach* is the use of skill

based practice and specific motor learning strategies which includes practice dictated and copied handwriting as writing from memory (Denton, Cope, & Moser, 2006).

Parameters of the Search:

It is important to know how thoroughly the literature was searched for research studies concerning the question. If the search was not intensive, important information may be lacking from the review.

Keywords: handwriting approaches, teaching learning disabled children handwriting, handwriting interventions, kinesthetic handwriting programs, multisensory approaches in handwriting, teaching handwriting, and therapeutic approaches to handwriting.

Website resources: Google Scholar, Pro Quest Nursing and Allied Health Source, Journals at Ovid Full Text, Science Direct, and Medline with Full Text.

EBPX Summary

Summary of the EBPX team on the collective evidence reviewed.

There are many studies that suggest using different handwriting approaches when working with students who have handwriting difficulties. The most recognized intervention programs included cognitive, multisensory, task oriented, kinesthetic, sensorimotor, and therapeutic practice. But which one of these is best in increasing handwriting skills in children who exhibit difficulty in handwriting?

Many of the occupational therapy interventions with students who have handwriting difficulties are based on the assumption that there is a relationship between sensorimotor impairment and handwriting dysfunction. It is then assumed that remediation of the sensorimotor impairments would result in improved handwriting ability (Denton, Cope, & Moser, 2006). Of surveyed Canadian occupational therapists, 90% use sensorimotor approaches to remediate sensorimotor impairment in children with handwriting dysfunction while 92% of surveyed American school based therapists used a multisensory approach (Denton, Cope, & Moser, 2006). Again we ask the question which is the best intervention in addressing handwriting problems?

The first article by Denton, Cope and Moser (2006), the authors were comparing whether the *sensorimotor approach* or the use of practice or *task oriented* in handwriting resulted in greater handwriting improvement. In this study those children who participated in the therapeutic practice of handwriting improved moderately when compared to both the sensorimotor and control group children. Those children in the sensorimotor group however did improve in sensorimotor components. Another study that compared sensorimotor to a task oriented group was by Weintraub, Yinon, Hirsch, and Perush (2009). In this study children were placed either in the sensorimotor group, a task oriented group or a control group. This study was not only looking at immediate results of

handwriting changes but also 4 months later. Both the sensorimotor and task oriented group made significant changes over the control group yet the study indicated that there is not a significant difference between the two interventions.

In looking at *kinesthetic programs*, a study by Sudawad, Trombly, Henderson, and Tickle-Degnen (2002) compared kinesthetic training to a handwriting practice group. At pretest no significant difference was noted between the students and again at post test which indicated that the kinesthetic program did not improve handwriting kinesthesia in children.

Cognitive groups such as the study by Zwicker, and Hadwin (2009) illustrated that children in second grade do not improve significantly without intervention of some kind while first graders do. In their study the use of three groups; cognitive, multisensory and a control group were sought to examine changes in handwriting. The results of this study indicated that the cognitive approach shows a greater success than multisensory which challenges today's occupational therapy intervention with handwriting.

There are *handwriting programs* that are being used in classrooms all over the country; some of these include Handwriting without Tears (HWT), Loops and Other Groups, or school district curriculums such as D'Nealian and Zaner-Bloser. In one such study by Marr, and Dimeo (2006) the authors looked at a sensorimotor approach by using the Handwriting without Tears (HWT) program yet used only a single group where all participated in the program some as cursive while majority was in manuscript. This study showed a significant change in both the production of upper and lower case letters in manuscript and in cursive yet may be related to the curriculum of teaching letter formation instead of sensorimotor components. A second study using a handwriting program was that of Roberts, Siever, and Mair (2010) where they used the Loops and Other Groups program. Significant improvement was noted in legibility of both baseline, closure and line quality of letters along with speed and personal attitude. The conclusion of this study was that Loops and Other Groups program does appear to have an impact on handwriting. Another study by Shimel, Candler, and Neville-Smith the authors compared three programs which included HWT, Loops and Other Groups, and the school district's curriculum of Zaner-Bloser. A pretest before group placement it was found that no significant difference was noted between the students as they were all performing on the same level. After participating in one of the three groups the results indicated no significant difference among the students which showed no one program was more effective than the other.

It is noted that children learn in different ways and different populations or ages of students may show better result with one intervention over another. Of the eight studies one indicated that the Loops and Other Groups showed improvement while still another indicated no significant difference comparing it with HWT and Zaner-Bloser. In a separate study with HWT the question remained if it was the sensory approach or the curriculum involved in teaching letter formation. Three of the eight studies indicated that the practice of letter formation with feedback for correct formation shows the best results. Only one of the studies indicated the cognitive was better and this was over a multisensory program while another indicated that sensorimotor was not better than the task oriented interventions. In comparing the studies with each other it seems that the practice of letter formation or a curriculum that is based on correct letter formation is the best way to teach those with handwriting difficulties. From this information it is also recommended that the cognitive approach should be also considered as an intervention for handwriting.

EBPX Strength and Impact Summary

Interpretation of the collective evidence reviewed by the EBPX team.

Strength of Evidence and its Impact on Therapy Intervention Decisions	
Strength of Evidence	Impact
Some evidence that this intervention is effective.	Therapists should give strong consideration to use of this intervention.

Evidence Table

Contains appraisals of evidence reviewed.

Level	1	2	3	4	5
Type of Evidence	Systematic Reviews and Meta-analyses	Randomized Control Trials (RCT)	Quasi-experimental And Comparative studies	Correlation and Non-experimental studies	Descriptive Studies & Expert Opinion articles

Citation	Types of Evidence & Access	Description of Evidence/ Types of Study	Levels of Evidence	Description of Population	Description of Intervention	Findings
Denton, P., Cope, S., & Moser, C. (2006). The effects of sensorimotor based intervention versus therapeutic practice on	Research Article	A three group study using pre and post test experimental design with a random assignment to sensorimotor, therapeutic practice or control group.	2	200 children ages 6 to 11 were tested with Test of Handwriting Skills (THS). 25% or 38 children qualified for the study with a population that	Thirty eight children after qualifying for the study were then tested using the following instruments; Developmental Test of Visual Perception (DTVP), Test of Manual Pointing (TMP), and The In Hand Manipulation (IHM). After all pretesting the children were randomly assigned	Children in the therapeutic practice group moderately improved in handwriting where the children in the sensorimotor intervention group declined in handwriting performance. The control group did not change significantly. Children in the sensorimotor group did improve in sensorimotor components.

improving handwriting performance in 6 to 11 year old children. <i>The American Journal Of Occupational Therapy, Vol 60;1 , 16-27.</i>				consisted of ages 6 to 11.2 years of age, 12 girls, 26 boys, 1 1st grader, 16 2 nd graders, 14 3 rd graders, 7 4 th graders, 34 with right handedness and 4 with left handedness.	to one of three groups; Sensorimotor group n=14. Therapeutic practice group n=15. Control group n=9. Groups met four times per wk for 5 wks. The sensorimotor group focused on 4 major components: visual perception, visual motor integration, kinesthesia and proprioception, and in hand manipulation. The therapeutic practice group focused on handwriting practice books to practice both dictated and copying handwriting along with writing from memory.	
Marr, D., Dimeo, S.B. (2006). Outcomes associated with a summer handwriting course for elementary students. <i>The American Journal of Occupational Therapy, Vol 60, 1, 10-15.</i>	Research Article	A single group pretest and posttest design.	4	Twenty six children responded to a flyer sent home to students attending local schools in New York. The single group consisted of 15 boys and 11 girls, 22 right handed and 4 were left handed. The Evaluation Tool of Children Handwriting (ETCH) was administered in cursive to 8 students and to 18 in manuscripts	The ETCH was administered both as a pretest and posttest. The Handwriting Without Tears program was used for a 2 week program consisting of 1 hour of instruction and a homework assignment each night with focus on writing one half to one full page nightly. During the 2 nd week of the program homework assignment began including writing of sentences and paragraphs.	Two areas of the ETCH, the lowercase and uppercase letter formation both indicated a significant change. The significant changes in these two areas may be result of the focus of the Handwriting Without Tears curriculum. The cursive group did make a significantly greater improvement in the formation of the uppercase letters. Those children who were receiving special education made more progress than those who did not attend special education. Children receiving special education made greater progress that their non special education peers in the area of lowercase writing.
Ratzon, N., Efraim, D., & Bart, O.	Research Article	A randomized study with an	2	Fifty-two children	All first graders were given the Berry Buktenica	The study tested how short term intervention can improve visual

<p>(2007). A short-term graphomotor program for improving writing readiness skills of first-grade students. <i>The American Journal of Occupational Therapy</i>, Vol 61, 4, 399-405.</p>		<p>intervention group and a control group.</p>		<p>participated in the study. Twenty four in the treatment group with 13 boys and 11 girls. The control group had 28 children with 12 boys and 16 girls</p>	<p>Developmental Test of Visual Motor Integration (VMI). Those children with the lowest scores were selected for the study. Seven exclusions resulted with 52 children for the study. The Developmental Test of Visual Perception (DTVP-2) was administered before and after intervention. The Bruininks-Oseretsky Motor Development Scale was administered to 15 children in the study group and only 24 in the control group due to technical problems, The intervention included 12 sessions, one time a week for 45 minutes. During each session the first 10 to 15 minutes consisted of fine motor activities and the remaining time included pencil and paper task.</p>	<p>motor skills in first graders who are from low socioeconomic backgrounds. Due to the difficulty in translating scores into U.S. norms raw score rather than standardized scores were used. This was derived by taking the posttest score minus the pretest score divided by the pretest score and then multiplied by 100. A significant difference was found in the treatment groups before and after intervention. A significant improvement was also found in the treatment group compared to the control group. Children in the study group made significant gains using both DTVP and Bruininks. The study concluded that intervention does help children with disabilities close their developmental gap.</p>
<p>Roberts, G., Siever, J., & Mair, J. (2010). Effects of a kinesthetic cursive handwriting intervention for grade 4-6 students. <i>The American Journal of Occupational Therapy</i>, Vol 64; 5, 745-755.</p>	<p>Research Article</p>	<p>A repeated measures design, with four time points, was used to evaluate the legibility, speed, and personal satisfaction with handwriting over time.</p>	<p>3</p>	<p>32 students participated in the study.84% were boys while 16% were girls. Ages of students ranged from 8yr 7mo to 11yr 11mo, 11 students from grade 4, another 11 students from grade 5, and lastly 10 students from grade 6.</p>	<p>Testing included three hand writing samples; copying "The quick brown fox jumped over the lazy dog", composition using the handwriting subtest from the Test of Written Language, and alphabet sample both connected and unconnected. Handwriting speed and quality was measured by The Test of Written Language (TOWL), The Handwriting Evaluation Scale (HES), and speed was evaluated on the</p>	<p>Study results indicated that 39% of the students improved in global legibility of cursive formation. Significant improvement was found in legibility components of baseline, closure, and line quality. Parents and teachers reported improvement in legibility, speed and attitude. Spacing did not improve significantly yet the Loops and Other Group program did not address this component. The speed of writing improved initially with the students but did not continue to improve over time. The conclusion of this study is that the Loops and Other Groups program</p>

					<p>copying sample. Intervention was based on the Loops and Other Groups program. Students participated in a 7-wk program in which the lower case letters were taught in 4 groupings based on the shared movement of the letters. Students were seen in small groups 1 time a week for an hour after school in a quiet area. During the additional weeks of program students also received homework sheets to be completed nightly with their parents for 15-20 minutes.</p>	<p>does appear to have an impact on developing handwriting skills.</p>
<p>Shimel, K., Candler, C., Neville-Smith, M. (2009). Comparison of cursive handwriting instruction programs among students without identified problems. <i>Physical & Occupational Therapy in Pediatrics, Vol 29, 2, 172-183.</i></p>	<p>Research Article</p>	<p>A three group study using a pretest and posttest design with random assignment to a Handwriting Without Tears, Loops and Other Groups, or the district's curriculum of Zaner-Bloser.</p>	<p>2</p>	<p>A convenience sample of 50 children from three third grade classrooms from three different schools within the same school district. All of the students had received instruction using the Zaner-Bloser cursive handwriting technique for the first 4 months of school.</p>	<p>Children were randomly selected to one of three groups; 18 were placed in the Handwriting Without Tears group, 17 in the Loops and Other Groups, and lastly 15 served as a comparison group where they were instructed only in Zaner-Bloser which is the districts cursive curriculum. The Evaluation Tool for Children's Handwriting-Cursive (ETCH-C) and the Error Recognition and Grading Scale (ERGS) were administered to all children in the study to obtain a baseline score. Intervention occurred over a 6 week period where students received 10-15 minutes of daily instruction</p>	<p>Pretest scores using the ETCH-C indicated that the 3 groups had no significant difference as all students were performing at the same level. A significant improvement was noted in all 3 groups in uppercase legibility from the pretest to the posttest. Those students in the district's curriculum also increased in lowercase legibility from the pretest to the posttest while the other two groups did not. None of the groups however indicated a significant change in total legibility from pretest to posttest. In comparing between the three groups of posttest scores on the ETCH-C there was no significant difference in legibility production among the three different programs. The conclusion of this study indicated that one program was no more effective than the other in producing legible cursive</p>

					in small groups of 5 to 7 students. Students in the Loops and Other Groups and Handwriting Without Tears groups were also exposed to the Zaner-Bloser curriculum in the regular classroom. After 6 weeks of intervention students were retested using the ETCH-C and ERGS to determine the amount of progress made compared to the baseline measurement.	handwriting
Sudawad,P., Trombly, A., Henderson, A., & Tickle-Degnen, L (2002). Testing the effect of kinesthetic training on handwriting performance in first grade students. <i>The American Journal of Occupational Therapy, Vol 56, 1, 26-33.</i>	Research Article	A randomized blinded three group research design. Groups consisted of a kinesthetic training group, a handwriting practice group and a no treatment group. Testing occurred on 3 occasions; a pretest within 1 week before treatment, a posttest within 1 week after treatment and a follow up at 4 weeks after the posttest.	2	45 first graders were recruited for the study with ages ranging from 6 years 2 months to 7 years 11 months. Participants included 30 boys and 15 girls.	Instruments used in this study included: The Kinesthetic Sensitivity Test (KST) contains two subtests; the Kinesthetic Acuity and the Kinesthetic Perception, The Evaluation Tool of Children's Handwriting (ETCH) and a teacher questionnaire that was development for this study. Children were randomly assigned to one of the three groups. The treatments began within 1 week after the pretest using the KST, the ETCH and the teacher questionnaire. The Kinesthetic training and the handwriting practice groups was provided for 30 minutes daily for 6 consecutive school days. The children were then re-evaluated 1 week after the treatment period and those in the no treatment group were evaluated for	No significant differences were judged by teachers at pretest. The effect of kinesthetic training on kinesthesia indicated a significant improvement of KST scores occurred over time yet this improvement was not significantly different among the groups. The effect of kinesthetic training on handwriting legibility indicated an objective measurement using the ETCH total word legibility scores had no significant difference being found between the pre and posttest. The total letter legibility indicated no significant change over time and changes from the pre and posttest were not significantly different among the groups. The ETCH total numeral legibility scores showed no significant difference found between pre and the posttest. Subjectively there was a significant improvement from the teacher questionnaire scores between the pre and posttest. Yet there was no significantly difference among the groups. The overall conclusion of this study is that Kinesthetic training did not

					posttest 2 weeks after the pretest. The follow up occurred 4 weeks after the posttest using only the teacher questionnaire.	improve handwriting or kinesthesia in children. There is no support from this study for using kinesthetic training to improve handwriting legibility in first grade students.
Weintraub, N., Yinon, M., Hirsch, I. B.-E., & Parush, S. (2009). Effectiveness of sensorimotor and task oriented handwriting intervention in elementary school aged students with handwriting difficulties. <i>The Occupational Therapy Journal of Research, Vol 29, 3, 125-134.</i>	Research Article	A pretest-posttest experimental design with random assignment to compare two different handwriting intervention programs.	2	Fifty five students from 2 nd to 4 th grade participated in the study. The sensorimotor group contained 19 students, 15 boys and 4 girls, 13 in 2 nd grade, 4 in 3 rd grade and 2 in 4 th grade. The task oriented group contained 19 students, 18 boys and 1 girl, 7 in 2 nd grade, 11 in 3 rd grade, and 1 in the 4 th grade. The control group contained 17 students, 17 boys and no girls, 10 in 2 nd grade, 4 in 3 rd grade, and 3 in 4 th grade. Students were seen for 8 weeks for 1 hour treatment sessions	Teachers completed the Brief Assessment Tool for Handwriting (BATH) and those receiving a score of one standard deviation below the mean were received into the study. Afterwards an entire battery of instruments were used including the Motor Accuracy Test (MAC), The Developmental Test of Visual Perception (DTVP-2) and two subtest from the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP), The Hebrew Handwriting Evaluation (HHE) was completed immediately after termination of the program and again during Stage 2 (4months later). Intervention was completed in 2 stages. The first stage with the immediate effects of intervention examined by comparing both groups with the control group. In stage 2 the long term intervention effects were measured after 4 months of post intervention. The sensorimotor program used 15 minutes at the beginning of each session to focus on preparatory activities to include	At stage 1 there was a statistically significant improvement in handwriting in both groups but not in the control group. In the stage 2 a statistically significant gain was noted again in both intervention groups. This study indicated that there is significant gain over the control group yet does not indicate superior performance of one intervention over the other program.

					postural control, bilateral coordination, stability, and fine motor activities. This was followed by handwriting activities that included learning a group of letters and practicing them with multisensory experiences. The task oriented group included handwriting practice with focus on improving handwriting with use of word games, writing sentences, and using a variety of writing tools.	
Zwicker, J. G., & Hadwin, A. F. (2009). Cognitive versus multisensory appraces to handwriting intervnetnion: A randomized controlled trial. <i>The Occupational Therapy Journal of Research</i> , Vol 2,1 , 40-48.	Research Article	Randomized Control Trial	2	72 children whom 51 were boys and 21 were girls, 45 students were from the 1 st grade and 27 were in the 2 nd grade.	The Beery-Buktenica Developmental Test of Visual Motor Integration (VMI) was used as a pretest for determining if students were developmentally ready to learn how to print based on their ability to copy the first eight geometric shapes using this test. The Evaluation Tool for Children's Handwriting (ETCH) was used to measure letter legibility as a pretest and posttest of handwriting. Intervention groups consisted of a cognitive, multisensory, and a control group. The treatment sessions were for 30 minutes one time a week for 10 weeks. The students in the control group received no additional intervention yet were expected to continue to receive handwriting instruction as part of their	The results of this study indicated that second grade students did not improve significantly in handwriting without intervention. It also illustrated that the second graders improved greater with the cognitive intervention approach when compared to the multisensory intervention approach. This is opposite of first grade students who improved with or without intervention. These findings suggest a challenge to the current occupational therapy intervention practice of using a multisensory approach for remediation of handwriting difficulties as the cognitive approach shows greater promise and is worthy of additional investigation.

					<p>school curriculum. Both of the treatment groups involved modeling, imitation, tracing, and copying task. In the cognitive intervention group the focus was placed on the cognitive awareness of letter formation and involved verbal mediation to guide the formation of letters. The therapist encouraged the students to talk about the letter and describe how to form them while no sensory experiences was involved. In the multisensory intervention group the students were exposed to a variety of textures in which to form the letters and were encouraged to attend to the feel of forming the letters.</p>	
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