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# Effects of a Classroom-Embedded Occupational Therapist–Teacher Handwriting Program for First-Grade Students

Jane Case-Smith, Lindy Weaver, Terri Holland

## MeSH TERMS

- schools
- handwriting
- occupational therapy
- program evaluation
- students
- writing

This study examined the effectiveness of Write Start, a handwriting and writing program cotaught by teachers and occupational therapists for first-grade children. Four classrooms ( $n = 80$ ) received the Write Start program, and four ( $n = 58$ ) received standard handwriting and writing instruction. Two teachers and an occupational therapist implemented the 24-session manualized program, which included station teaching and individualized supports. The program emphasized practice in small groups in which the coteaching team provided students with frequent feedback, encouraged self-evaluation, and facilitated peer modeling and peer evaluation. Students who completed the Write Start program improved more in handwriting legibility and speed than the group receiving standard instruction. Writing fluency and written composition were no different between groups at posttest; however, writing fluency was significantly higher for Write Start students at 6-mo follow-up. Write Start students with low legibility at baseline made significant improvements, suggesting that the program may benefit students at risk for handwriting and writing problems.

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**Jane Case-Smith, EdD, OT/L, FAOTA**, was Professor and Director, Occupational Therapy Division, The Ohio State University, Columbus, at the time of the study.

**Lindy Weaver, MOT, OTR/L**, is PhD Candidate, Occupational Therapy Division, The Ohio State University, 406 Atwell Hall, 453 West 10th Avenue, Columbus, OH 43210; [Lindy.Weaver@osumc.edu](mailto:Lindy.Weaver@osumc.edu)

**Terri Holland, MS, OTR/L**, is Occupational Therapist, Dublin City Schools, Dublin, OH.

Although in the past handwriting was taught throughout the elementary grades, in recent years the emphasis on reading and math has increased and handwriting instruction has become minimal (Berninger et al., 2006; Cahill, 2009). Students with high aptitude for handwriting may acquire legibility despite limited instruction in handwriting; however, at least 25% of students appear to need specific instruction to learn handwriting (Volman, van Schendel, & Jongmans, 2006). These students often have illegible or poor-quality handwriting that affects teachers' perceptions of their writing, resulting in lower grades across subjects (Graham, Harris, & Fink, 2000).

Students who struggle with handwriting may expend their cognitive resources on the motor planning required to form letters rather than on composition and written expression of an idea (Baker, Gersten, & Graham, 2003; Cahill, 2009; Graham & Weintraub, 1996). Thus, handwriting legibility and speed can affect learning to write and lower written proficiency across academic subjects (Graham, 2009; Graham et al., 2008). When students become fluent and automatic in handwriting, they can focus their cognitive resources on ideas and subject knowledge (Berninger et al., 2006).

## Handwriting Instruction and Intervention

Supplemental handwriting instruction (e.g., Handwriting Without Tears; Olsen, 1999) provided in addition to the standard curriculum has resulted in beneficial effects for elementary-age students with handwriting difficulties (Berninger et al., 1997; Graham & Harris, 2005; Graham et al., 2000; Howe, Roston, Sheu, &

Hinojosa, 2013). These interventions have focused on legibility, writing fluency, and composition. First-grade students have demonstrated significant improvement in writing fluency from handwriting instruction that used a developmental approach with visual cues for letter formation and memory retrieval (Berninger et al., 1997). Efficacious handwriting instruction programs also have embedded practice with frequent reinforcement (Graham, 2009). Although these supplemental interventions had positive effects on students' handwriting and writing, providing supplemental instruction and tutoring outside the classroom may detract from students' work in other academic areas and may not be a feasible model for school systems with limited resources.

Specific handwriting interventions for students who struggle with handwriting have applied multisensory approaches (Case-Smith, 2002; Denton, Cope, & Moser, 2006; Schneck & Amundson, 2010) and cognitive strategies (Banks, Rodger, & Polatajko, 2008; Weintraub, Yinon, Hirsch, & Parush, 2009). In multisensory approaches, students practice the foundational sensory–motor skills of handwriting (e.g., through activities that require manipulation of small objects, haptic and visual perception, or visual–motor integration). In interventions using cognitive strategies, students are visually or verbally cued on letter formation, provided systematic mnemonics, given opportunities to practice extensively, and provided extensive feedback. Handwriting interventions emphasizing cognitive strategies have emphasized student problem solving, self-regulation, and self-evaluation (e.g., Weintraub et al., 2009). Although these handwriting interventions have resulted in positive handwriting effects, they have not been well linked to the writing curriculum; that is, the interventions often emphasize letter formation without reinforcing the importance of legibility for writing and composition.

In summary, handwriting and writing instruction and intervention programs with evidence of effectiveness include practice of underlying sensorimotor skills (Case-Smith, 2002), visual cueing that promotes memory of letter formation (Berninger et al., 1997, 2006), practice with reinforcement (Graham et al., 2000), specific mnemonics for letter formation (Graham et al., 2000), self-evaluation (Lane et al., 2008; Weintraub et al., 2009), and peer modeling and support (Harris, Graham, & Mason, 2006). These interventions are implemented individually or in small groups in sessions outside the classroom without full integration into the writing curriculum. Handwriting and writing programs cotaught by occupational therapists and teachers that are embedded within the classroom can prevent handwriting problems that often develop when

writing demands increase. In particular, such an interdisciplinary approach may promote writing development in students who struggle to learn handwriting.

## Write Start: A Coteaching Model

We developed a handwriting and writing program that is cotaught by teachers and occupational therapists to provide well-designed instruction with classroom-embedded individualized supports to prevent handwriting problems and promote writing fluency in first-grade students of all ability levels (Case-Smith, Holland, & Bishop, 2011; Case-Smith, Holland, Lane, & White, 2012). The 24 sessions of handwriting and writing instruction use team teaching and station teaching methods (see Cook & Friend, 1995) that emphasize students' active participation. Practice of handwriting and writing is shaped and reinforced by frequent teacher or therapist feedback. A highly collaborative model is used in which the teachers and occupational therapist meet weekly to review student progress and to plan the weekly sessions. The coteaching team targets low-performing and at-risk students by providing frequent feedback, encouraging self-evaluation, and facilitating peer modeling and supports for students (Case-Smith, Holland, & White, 2014).

## Research Aims and Questions

This study examined the effectiveness of the cotaught Write Start program for first-grade students across 2 yr of implementation. One aim was to evaluate effectiveness for students who participated in the Write Start program compared with students who received the standard handwriting and writing curriculum. Because the Write Start program targets at-risk students who demonstrate handwriting problems, a second aim was to determine whether the program would benefit students with diverse learning needs—that is, those who enter the program at different levels of handwriting legibility. The research questions that guided this study were as follows:

1. Did the Write Start program, when compared with standard handwriting and writing instruction, result in greater improvement in handwriting legibility and speed, writing fluency, and written composition in first-grade students?
2. Did students with low, average, and high baseline handwriting legibility who completed the Write Start program make significant progress and demonstrate significantly different rates of progress in handwriting legibility and speed, writing fluency, and written composition?

## Method

### *Research Design*

The study used a nonrandomized comparison of the Write Start program with standard handwriting and writing instruction for first-grade students. We used a convenience sample of public school classrooms in a suburban midwestern U.S. school district. The study was approved by the university and the school district. We administered measures of handwriting legibility and speed, writing fluency, and written composition at pretest, posttest, and 6-mo follow-up and analyzed results among students with different baseline ability who completed the Write Start program.

### *Sample*

The district approved the participation of eight first-grade classrooms, four of which received the Write Start program and four of which received standard instruction. Students in first-grade regular education classrooms for whom English was their first language were included. Exclusion criteria were Down syndrome or autism, severe visual or hearing loss, and English spoken as a second language. One student with Down syndrome, 2 with autism spectrum disorder, and 1 for whom English was a second language participated in the Write Start program, but their data were not included in the analyses. Parents were informed about the study during student orientation at the start of the school year. Parents completed consent forms at the time of the teachers' initial student assessment before the school year began. The Write Start group comprised 80 students (39 boys), and the standard instruction group consisted of 59 students (32 boys).

### *Intervention*

*Write Start Program.* The Write Start program included twenty-four 45-min sessions implemented twice a week for 12 wk during the first term of the first grade. The coteaching team taught all 26 lowercase manuscript letters in a developmental sequence (from easy to difficult stroke sequence). Each session included instruction, practice in small groups with peer and self-evaluation, activities to reinforce handwriting fundamentals, and story writing activities. Following evidence-based principles from prior handwriting and writing research, the teachers and occupational therapist

1. Modeled letter formation (using continuous stroke) and provided simple, consistent verbal and visual cues for letter formation;
2. Used stations where small groups of students participated in activities emphasizing motor planning and

manipulation, visual–motor integration, and cognitive learning;

3. Provided frequent feedback during handwriting practice that included correcting errors, encouraging self-evaluation, and providing praise;
4. Promoted peer modeling and feedback by pairing students and establishing strategies for students to share their writing; and
5. Monitored and assessed students' performance to guide the selection of specific handwriting instructional strategies.

Each week, the coteaching team met to review student progress and plan the week's handwriting and writing sessions. Individual and overall class performance from the previous week was reviewed to select activities and strategies for the upcoming week, including adaptations and supports for individual students. Individualized supports and interventions (e.g., pencil grips, colored or textured paper) were implemented during the sessions. Following the established principles, both weekly sessions included an emphasis on immediate feedback, self-evaluation, and peer modeling and supports (e.g., students were encouraged to share their writing and provide feedback to their peers).

### *Standard Handwriting and Writing Instruction Group.*

The comparison group in the standard instruction classrooms followed the district's writing curriculum. Four teachers provided handwriting instruction 3–4 days per week, spending 15–20 min in the morning to introduce or review 1–2 letters. The teachers reinforced letter formation in the students' writing assignments or in the "sentence of the day." The students completed short writing assignments, such as letters to their parents, almost daily. Each teacher used the district's curriculum, which included word books and visual models of the letters. The teachers using the standard handwriting and writing curriculum dedicated similar amounts of classroom time to handwriting and writing as the Write Start coteaching teams (between 900 and 960 min; Case-Smith et al., 2014).

### *Coteaching Teams*

Each coteaching team included a first-grade teacher, an intervention specialist (special educator), and an occupational therapist. The same two coteaching teams implemented the Write Start program in both years. The professional experience of the teachers and occupational therapist ranged from 5 to 20 yr. All team members completed informed consent documents and were trained by the first and third authors (Jane Case-Smith and Terri Holland). Each year,

the team was interviewed at the end of the program to gather their perceptions of the program and use of a co-teaching model.

### *Intervention Fidelity*

A fidelity measure for the Write Start program was developed using the core principles to define expected occupational therapist and teacher behaviors. The fidelity checklist allowed the team to assess the key components of the program, including instructor-provided modeling, specific instructions, visual cues, verbal cues, immediate feedback, positive feedback, and individualized guidance. It also enabled the team to rate how well the activities provided multisensory experiences, allowed student practice, facilitated student self-evaluation, promoted peer supports, and provided structure and organization. Each instructional element was scored as performed with complete consistency, partial consistency, or inconsistency. The reliability of the fidelity instrument was established in a pilot study (Case-Smith et al., 2011). For both years, graduate assistants scored the fidelity assessment for 18 of 24 sessions of the Write Start program.

### *Measures*

Students were evaluated individually at baseline and at 1 wk and 6 mo after the intervention using the Evaluation Tool of Children's Handwriting–Manuscript (ETCH–M; Amundson, 1995) and the Writing Fluency and Writing Samples tests of the Woodcock–Johnson III Tests of Achievement (WJIII; McGrew, Schrank, & Woodcock, 2007). Graduate students evaluated each student in a quiet space. The evaluators were blinded to time and group when scoring handwriting and writing at pretest and posttests. They were blinded to group when scoring the 6-mo follow-up tests.

Lowercase legibility and speed were assessed using the ETCH–M. Students were required to write the lowercase alphabet by memory. A percentage score was generated based on the number of legible letters, using the manual's criteria for legibility. The time (in seconds) a student required to write the lowercase alphabet yielded a speed score.

The ETCH–M has demonstrated moderate test–retest reliability coefficients ( $r = .77$ ) for total letter legibility (Diekema, Deitz, & Amundson, 1998). Construct validity comparing the ETCH–M and teachers' ratings of handwriting was high (Feder, Majnemer, Bourbonnais, Blayney, & Morin, 2007). We also found a high correlation between the teachers' ratings of handwriting and ETCH–M scores (95% agreement).

The WJIII Writing Fluency test was used in instructing students to compose a short sentence from three words written beside a picture. The timed standard procedures and criteria were used. A student was awarded 1 point for each grammatical sentence that used all three words exactly as they were listed. For the WJIII Writing Samples test, students were instructed to write a word or a sentence describing a picture. This test required retrieval of word meaning and syntactic information.

The WJIII is a norm-referenced, widely used test of academic achievement. Reliability for the Writing Fluency and Writing Samples tests is high, and interrater reliability is good ( $r_s = .89-.90$ ; McGrew et al., 2007).

### *Data Analysis*

To analyze differences between the Write Start and standard instruction students, we first performed regression modeling for each variable (ETCH–M and WJIII scores) to determine the classroom effect on the posttest scores. The classroom effect was not significant for any variable; therefore, we compared pre- to posttest scores for the Write Start and standard instruction groups using a two-way (Group  $\times$  Time) repeated-measures analysis of variance (ANOVA). To determine group differences between pretest and 6-mo follow-up test scores, we used a two-way repeated-measures ANOVA with a Bonferroni adjustment for multiple comparisons (two ETCH–M measures and two WJIII raw scores). We calculated effects for all measures using Cohen's  $d$  by comparing the groups' pre- to posttest differences divided by the mean standard deviations.

To group the Write Start students by initial handwriting ability, we used baseline lowercase legibility pretest scores from the ETCH–M to categorize students into low- (<50% legible letters), average- (50%–80% legible letters), and high-performing (>80% legible letters) subgroups. ETCH–M legibility scores were validated by teacher ratings of each student's first handwriting sample (rated 1–3). To compare the pretest, posttest, and follow-up scores for the three handwriting ability groups, we again used repeated-measures ANOVA. For all analyses, a Greenhouse–Geisser adjustment was applied to the degrees of freedom for the ANOVA when Mauchly's test of sphericity (Portney & Watkins, 2009) was significant at the .05 level. All analyses were performed using IBM SPSS (Version 19.0; IBM Corporation, Armonk, NY).

## **Results**

The 24 sessions of the Write Start program were implemented with high fidelity across the four classrooms. The

instructors and occupational therapist achieved 94%–96% fidelity (i.e., implemented each criterion consistently [in >90% of opportunities]). All sessions were provided, and all students attended 20 or more of the 24 sessions. The Write Start group included 80 students (39 boys; ages 71–98 mo; mean age = 78.5 mo, *SD* = 4.7). Between pretest and posttest, 1 student in the standard instruction classrooms left the district; therefore, the standard instruction group comprised 58 students (32 boys; ages 65–91 mo; mean age = 79.1 mo, *SD* = 5.1). Three Write Start students left the district between posttest and follow-up; therefore, 77 Write Start students (38 boys) were included in the follow-up analysis.

### Comparison of Write Start and Standard Instruction Effects

All students made highly significant improvements in handwriting legibility,  $F(1, 136) = 136.9, p < .001$ . Compared with students in standard instruction, students in the Write Start program improved significantly more in lowercase legibility,  $F(1, 136) = 15.8, p < .001, d = 0.60$ . At posttest, the Write Start students had gained 23.1% in legibility compared with 11.4% for the standard instruction students. Both groups made significant improvements in speed,  $F(1, 136) = 145.2, p < .001$ ; however, the Write Start students improved more,  $F(1, 136) = 4.1, p = .025, d = 0.52$ . Write Start students increased their speed by 127 s compared with 87 s for the standard instruction students.

Pretest and follow-up scores are compared in Table 1. At 6-mo follow-up, the Group  $\times$  Time interaction remained significant,  $F(1, 130) = 11.5, p = .001, d = 0.59$ , indicating that the Write Start students improved more in legibility. The difference in handwriting speed between the Write Start students and the students in standard instruction also remained significant at 6-mo follow-up,  $F(1, 130) = 5.9, p = .016, d = 0.58$ .

For WJIII Writing Fluency and Writing Samples, the two groups performed similarly at posttest, and the

Time  $\times$  Group interaction effect was not significant (Writing Fluency,  $d = 0.06$ ; Writing Samples,  $d = 0.24$ ; see Table 1). At 6-mo follow-up, the Write Start students demonstrated significantly more improvement than the standard instruction group in Writing Fluency,  $F(1, 130) = 8.0, p = .005, d = 0.60$ . The Write Start students improved by 7.6 points and the standard instruction group by 5.4 points. At follow-up (Table 1), the groups did not differ on the Writing Samples scale,  $F(1, 130) = 0.6, p = .456, d = 0.11$ , and both groups scored near the maximum points possible, suggesting a ceiling effect.

### Comparison of Write Start Students Categorized by Baseline Legibility

To determine whether the Write Start program benefited students with differing initial handwriting legibility, we compared the performance of students categorized by their baseline legibility scores. The low-performing group (<50% legibility) consisted of 24 students (16 boys, 6 with individualized education programs [IEPs]), the average-performing group (50%–80% legibility) consisted of 34 students (17 boys, 0 with IEPs), and the high-performing group (>80% legibility) consisted of 19 students (6 boys, 1 with an IEP). Comparison of pretest, posttest, and follow-up scores on ETCH–M lowercase legibility showed that all groups made significant improvement in legibility at 6-mo follow-up (low, 39.6%; average, 29.9%; high, 12.7%; Table 2). The high-performing students showed a ceiling effect; the low- and average-performing students made meaningful changes in legibility. A Time  $\times$  Group interaction effect indicated that the low-performing group improved significantly more than the high-performing group,  $F(4, 148) = 11.44, p < .0001$  (see Figure 1).

In handwriting speed, all groups gained speed and were significantly faster in handwriting at follow-up, with the average- and low-performing groups gaining more than 150 s (see Table 3). The changes at 6-mo follow-up were significantly different among these groups, demonstrating

**Table 1. Comparison of the Write Start Group With the Standard Instruction Group on Pretest and Follow-Up Scores on the ETCH–M and WJIII Writing Fluency and Writing Samples Tests**

Measure	Write Start Group ( <i>n</i> = 77), Mean ( <i>SD</i> )		Standard Instruction Group ( <i>n</i> = 55), Mean ( <i>SD</i> )		<i>F</i> ( <i>p</i> )	Effect size, Cohen's <i>d</i>
	Pretest	Follow-up	Pretest	Follow-up		
<b>ETCH–M</b>						
Lowercase legibility, %	59.5 (20.9)	88.2 (13.4)	68.2 (20.4)	86.7 (15.0)	11.5 (.001)	0.59
Lowercase speed, s	221.2 (121.7)	81.2 (41.3)	190.1 (109.7)	95.4 (38.5)	5.9 (.016)	0.58
<b>WJIII</b>						
Writing Samples, raw scores	7.4 (2.6)	10.6 (1.7)	7.8 (2.7)	10.7 (1.8)	0.6 (.456)	0.11
Writing Fluency, raw scores	1.3 (2.0)	8.9 (5.0)	1.6 (3.0)	7.0 (5.3)	8.0 (.005)	0.58

Note. ETCH–M = Evaluation Tool of Children's Handwriting–Manuscript; *SD* = standard deviation; WJIII = Woodcock–Johnson III Tests of Achievement.

**Table 2. ETCH-M and WJIII Scores for Write Start Students, Grouped by Baseline Legibility**

Subscale and Time	Low-Performing Group ( <i>n</i> = 24), Mean ( <i>SD</i> )	Average-Performing Group ( <i>n</i> = 34), Mean ( <i>SD</i> )	High-Performing Group ( <i>n</i> = 19), Mean ( <i>SD</i> )
ETCH-M lowercase legibility, %			
Pretest	38.7 (11.4)	60.3 (12.0)	84.4 (13.4)
Posttest	72.9 (23.1)	84.7 (11.3)	94.2 (8.8)
Follow-up	78.3 (16.8)	90.2 (9.2)	97.1 (4.4)
ETCH-M lowercase speed, s			
Pretest	264.3 (145.7)	231.2 (117.6)	148.8 (42.5)
Posttest	108.8 (37.1)	93.8 (39.2)	69.5 (23.4)
Follow-up	100.1 (57.3)	79.3 (29.8)	60.5 (21.2)
WJIII Writing Fluency, raw scores			
Pretest	0.4 (0.7)	1.1 (1.6)	2.6 (2.8)
Posttest	1.9 (2.8)	5.9 (4.5)	6.2 (5.2)
Follow-up	5.8 (4.6)	9.7 (4.6)	11.4 (4.2)
WJIII Writing Samples, raw scores			
Pretest	5.5 (2.1)	7.5 (2.3)	9.5 (2.0)
Posttest	8.0 (2.3)	9.8 (1.8)	10.5 (1.9)
Follow-up	9.8 (1.8)	10.5 (1.7)	11.5 (0.8)

*Note.* Low-performing students had <50%; average-performing students, 50%–80%; and high-performing students, >80% legibility at baseline. ETCH-M = Evaluation Tool of Children’s Handwriting–Manuscript; Mean = marginal mean, *SD* = standard deviation; WJIII = Woodcock–Johnson III Tests of Achievement.

a Time × Group interaction effect,  $F(4, 148) = 3.07, p = .018$  (see Figure 2).

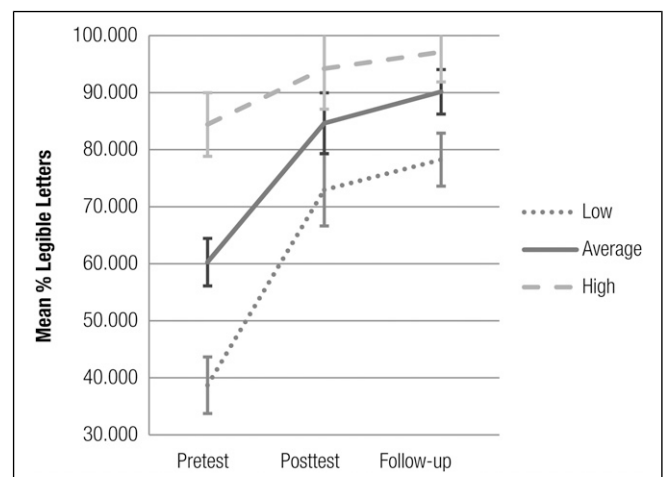
We compared improvements in Writing Fluency and Writing Samples scores across groups. In Writing Fluency, all Write Start students improved significantly,  $F(4, 148) = 131.57, p < .001$ , and the Group × Time interaction was significant,  $F(4, 148) = 3.77, p < .006$ . The high- and average-performing groups improved more (8.8 and 8.6 points, respectively) than the low-performing group (5.4 points), suggesting that the low-performing group continued to need supports to increase writing fluency (see Table 2). All of the groups made significant improvement on the Writing Samples test,  $F(2, 148) = 98.78, p < .001$ , and each group was near the scale’s ceiling at follow-up, suggesting limited sensitivity to change over time and across groups. The low-performing group improved most (4.3 points) compared with the average- (3.0 points) and high-performing (2.0 points) groups; however, the scale’s ceiling effect clearly limited improvement in scores for these groups. The Time × Group interaction was significant,  $F(4, 148) = 4.994, p < .001$ .

## Discussion

Using evidence-based principles for handwriting and writing instruction, we implemented the 12-wk manualized, cotaught Write Start program with high fidelity in the first-grade classrooms. The program has components similar to the handwriting and writing interventions developed by Graham and Harris (e.g., Harris et al., 2006) emphasizing frequent feedback, self-regulation, and self-evaluation as critical elements in improving handwriting

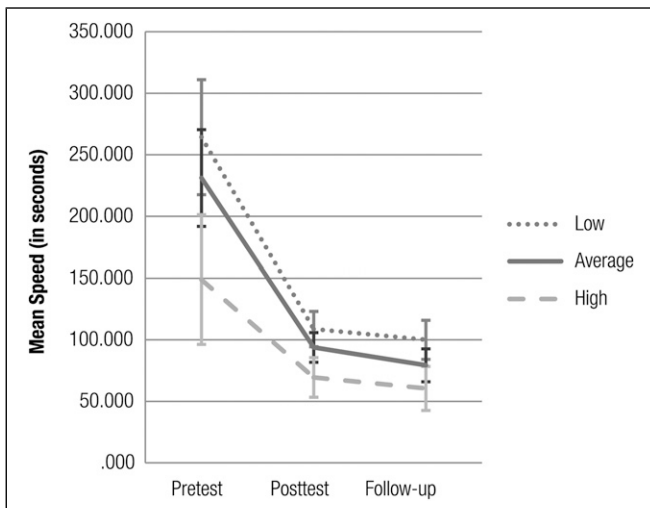
and writing in elementary-age students. The program also leverages peer supports to promote the social context of learning to write legibly. Writing, in particular, requires students to focus on both their ideas and the means to communicate those ideas. During this early stage of writing development and beyond, self-regulatory processes, such as goal setting, self-monitoring, self-instruction, and self-reinforcement, are strategies important to effective writing (Lane et al., 2008).

The Write Start program was designed to build the foundational skills needed to write fluently and to engage in written composition. Although both handwriting and writing are emphasized, the strongest effects in our sample



**Figure 1. Mean ETCH-M lowercase legibility scores for the Write Start students, grouped by initial legibility ranking.**

*Note.* Scores are represented as percentage of legible letters; 95% confidence intervals are of estimated marginal means. ETCH-M = Evaluation Tool of Children’s Handwriting–Manuscript.



**Figure 2. Mean ETCH-M lowercase speed scores for the Write Start students, grouped by initial legibility ranking.**

*Note.* Time is represented in seconds; 95% confidence intervals are of estimated marginal means. ETCH-M = Evaluation Tool of Children's Handwriting-Manuscript.

were in handwriting legibility and speed, and the effects on writing fluency were not evident until 6 mo after the program's end. We hypothesize that the focus on handwriting and foundational skills may have allowed the students to achieve automaticity in handwriting. Writing with confidence and automaticity may allow students to focus more on the writing process (Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Graham et al., 2000). Others have demonstrated that writing fluency increases after the basics of letter formation, alignment, and sizing are learned (Berninger et al., 1997; Graham et al., 2000).

Although coteaching models have been advocated as an inclusive service delivery model to address students' diverse learning needs, few studies of coteaching have been published (e.g., Kloo & Zigmond, 2008; Mastropieri et al., 2005). Our team of two teachers and an occupational therapist monitored, guided, and provided feedback to students in groups of 7 or 8. Because the small groups included students with high-, average, and low-level skills, they were optimal for promoting peer modeling and peer supports. The planning and review meetings allowed the coteaching team to reflect on students' progress, identify individual student problems, and plan remediation and accommodations. Other coteaching studies have also demonstrated these benefits (e.g., Rea, McLaughlin, & Walther-Thomas, 2002), although ours appears to be the first coteaching model to focus on teaching handwriting and writing.

Approximately 25% of students struggle with handwriting (Graham et al., 2008) and can benefit from additional supports or accommodations when writing. In our sample, students with low, average, and high initial hand-

writing legibility appeared to benefit from the coteaching model. Targeted to students at risk for handwriting and writing problems, Write Start promotes handwriting automaticity and writing fluency to prepare students for the writing demands of second grade and beyond. The investment of teachers and occupational therapists in this structured program may prevent later referrals to occupational therapy for handwriting problems that often appear when writing demands increase. Students in our sample who were initially low in handwriting skills appeared to catch up to higher performing students, suggesting that the program changed their developmental trajectory.

## Implications for Occupational Therapy Practice

The results of our study have the following implications for occupational therapy practice:

- Using coteaching models, occupational therapy practitioners and teachers can provide evidence-based instruction and individualized interventions to meet the diverse needs of first-grade students.
- When occupational therapy interventions are embedded in the classroom, both the teacher and the occupational therapy practitioner can monitor students' responsiveness and adapt intervention strategies to improve their effectiveness.
- The Write Start program enables teachers to integrate handwriting instruction into the writing curriculum. This collaborative intervention includes weekly meetings of the coteaching team to review student progress, plan the sessions, and design individualized interventions.
- Coteaching requires high levels of flexibility, open communication, willingness to adapt a plan, and investment in coming to consensus when alternate views are presented (Case-Smith et al., 2012; Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010).
- Students with diverse learning needs appear to benefit from a coteaching model that combines intensive practice, monitoring and immediate feedback, peer modeling and feedback, and student self-evaluation.

## Study Limitations

We did not randomize group assignment, and blinding was limited (scoring but not administration was blinded). The study was implemented in a middle-class suburb with limited socioeconomic diversity among the students. The Write Start program was implemented with high fidelity by two trained teams; use of additional teams would increase

the generalizability of the findings. One of the measures (WJIII Writing Samples test) was of limited value in measuring effects because it demonstrated a ceiling effect with this group of students. In future studies, use of a different assessment of written expression is recommended.

## Conclusion

The cotaught, classroom-embedded Write Start program provides small-group learning and reinforces practice of handwriting and writing by first-grade students. Teachers and an occupational therapist use station teaching, monitor practice, provide immediate and individualized feedback, encourage peer supports and modeling, and encourage students' self-evaluation. Students in this study who completed the Write Start program improved more than those in the comparison group in legibility and handwriting speed, achieving moderate positive effects. Although they did not improve more in writing fluency immediately following the program, they demonstrated higher writing fluency 6 mo after the program.

When effects for low-, average-, and high-performing students were analyzed, all groups showed gains. Six months after the program, the low-performing students had made greater gains than the high-performing students in handwriting legibility, and the average- and high-performing students had made greater progress in writing fluency. The study's findings suggest that a cotaught Write Start program may benefit first-grade students at risk for handwriting and writing problems, potentially promoting their writing development and success when writing demands increase in later grades. ▲

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