# Effect of a Coteaching Handwriting Program for First Graders: One-Group Pretest–Posttest Design

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- faculty
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- program evaluation

We examined the effects of a cotaught handwriting and writing program on first-grade students grouped by low, average, and high baseline legibility. The program's aim was to increase legibility, handwriting speed, writing fluency, and written expression in students with diverse learning needs. Thirty-six first-grade students in two classrooms participated in a 12-wk handwriting and writing program cotaught by teachers and an occupational therapist. Students were assessed at pretest, posttest, and 6-mo follow-up using the Evaluation Tool of Children's Handwriting–Manuscript (ETCH–M) and the Woodcock–Johnson Writing Fluency and Writing Samples tests. Students made large gains in ETCH–M legibility ($\eta^2 = .74$), speed ($\eta^2$s = .52–.65), Writing Fluency ($\eta^2 = .58$), and Writing Samples ($\eta^2 = .59$). Students with initially low legibility improved most in legibility; progress on the other tests was similar across low-, average-, and high-performing groups. This program appeared to benefit first-grade students with diverse learning needs and to increase handwriting legibility and speed and writing fluency.

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Students who struggle to learn handwriting are often referred to occupational therapy for intervention. Handwriting problems are one of the most common reasons for referral to school-based occupational therapy (Feder, Majnemer, & Synnes, 2000; Woodward & Swinth, 2002). Clinicians most often provide interventions using a one-on-one model of direct services outside the classroom. As described in the literature, occupational therapy handwriting interventions frequently use sensorimotor approaches that emphasize foundational skills combined with teaching–learning approaches that emphasize cognitive strategies (Weintraub, Yinon, Hirsch, & Parush, 2009; Zwicker & Hadwin, 2009).

## Handwriting Intervention Research

Research reports on occupational therapy handwriting interventions have demonstrated benefits for children with handwriting difficulties. Denton, Cope, and Moser (2006) compared the effects of sensorimotor intervention (i.e., emphasis on visual perception, visual–motor integration, in-hand manipulation) and therapeutic handwriting practice (i.e., extensive practice that included modeling and cueing in authentic writing tasks) for children with handwriting problems. The children who received therapeutic practice improved significantly in handwriting over time and improved more than the group that received sensorimotor interventions, suggesting that emphasis on cognitive strategies (i.e., practicing handwriting in authentic writing tasks) might be more effective than emphasis on foundational, sensorimotor skills.

Zwicker and Hadwin (2009) also examined the effect of cognitive versus multisensory interventions on handwriting legibility in students who had handwriting difficulties. First- and second-grade students were randomly assigned to

one of three groups receiving (1) a cognitive intervention that was modeled on one by Graham, Harris, and Fink (2000) and included modeling, imitation, discussion, and practice; (2) a multisensory intervention that included tactile, kinesthetic, and visual strategies for learning letters; or (3) a control group. The individualized intervention was provided once per week for 10 wk. Using scores on the Evaluation Tool of Children's Handwriting–Manuscript (ETCH–M; Amundson, 1995), the first-grade students improved in handwriting legibility with or without intervention. The second-grade students improved more with the cognitive intervention than with the multisensory intervention.

In a third study that compared sensorimotor interventions with cognitive strategies, second- to fourth-grade students with handwriting difficulties were assigned to a sensorimotor, task-oriented (cognitive), or control group (Weintraub et al., 2009). The intervention program included eight 1-hr sessions in groups of 4–6 students. In the sensorimotor condition, students practiced writing with added kinesthetic, tactile, or auditory feedback. In the task-oriented condition, students practiced writing in authentic writing tasks with instructor feedback. Immediately postintervention, both intervention groups improved more than the control group; however, only the task-oriented group's improvement was significant. The children continued to improve after the formal intervention ended, and the differences between the two intervention groups were minimal. Weintraub and colleagues (2009) concluded that both interventions appeared to be beneficial and that the effects could be attributed to aspects of the two interventions that were similar (e.g., handwriting practice).

Other handwriting interventions developed and researched by educators have resulted in beneficial effects on elementary-age students with handwriting difficulties (Berninger et al., 1997; Graham & Harris, 2005; Graham et al., 2000; Harris, Graham, & Mason, 2006). These interventions, which often supplemented standard classroom instruction, focused on legibility, writing fluency, and composition. Therefore, these researchers placed the goal of handwriting in the context of writing. In Berninger et al. (1997), first-grade students at risk for handwriting difficulties were placed in tutorial groups that provided different types of handwriting interventions. The intervention that included visual cues for letter formation (arrows directing how to form the letter) combined with memory retrieval (the students wrote the letter without a model) was most effective. Graham and Harris (2005) administered a supplemental handwriting instruction to first-grade children at risk for handwriting problems. Students who received the additional handwriting instruction improved more than did a control group in both handwriting and composition skills.

Although these interventions had positive effects, providing supplemental instruction, tutoring, or direct interventions outside the classroom may have certain negative consequences. For example, extra time spent on handwriting may detract from students' work in other academic areas, and supplemental instruction may not be a feasible model for school systems with limited resources.

## Inclusive Models of Handwriting Interventions

Classroom-embedded models for delivery of occupational therapy services have been developed to meet the mandate of inclusive education in the Individuals With Disabilities Education Act (Giangreco, 1986; Rainforth & York-Barr, 1997). In these models, the occupational therapist provides assessment and intervention in the classroom, allowing the student to remain in his or her natural context (Bazyk et al., 2009). Classroom-embedded services can result in optimal accommodations for students because they are developed and evaluated in the student's natural environment. *Consultation* is a classroom-based service in which the occupational therapist recommends teacher-implemented adaptations and accommodations for students with disabilities; it can include training the teacher in specific interventions to implement with a student (Sandler, 1997). Consultation models do not always result in ideal occupational therapist participation in services to the child; they can evolve into delegation of intervention implementation to the teacher with minimal participation of the occupational therapist. When students need ongoing assessment to plan and coordinate their program, other models of service delivery are needed (Case-Smith & Holland, 2009).

One model of inclusive intervention is *coteaching,* which usually consists of a general educator paired with a special education teacher or related services professional (e.g., occupational therapist, speech–language pathologist) providing instruction to a class. When an occupational therapist participates in coteaching, the teacher and therapist collaboratively plan, coordinate, implement, and evaluate the classroom instruction. As a partnership between the teacher and occupational therapist, coteaching involves jointly developing goals, making decisions about classroom management, planning instruction and interventions, and evaluating student performance (Beamish, Bryer, & Davies, 2010; Bessette, 2008; Gately & Gately, 2001). Although different models of coteaching

have been proposed, most often the role of the related services professional is to support the traditional role of the general education teacher. In this role, the occupational therapist adapts the curriculum, modifies materials, and provides specific interventions to students. The goal of coteaching is to provide different areas of expertise that, when combined, enhance instruction for all students (Murawski & Dieker, 2004). With a well-honed partnership, coteaching can increase learning outcomes for all students while embedding accommodations for students with disabilities (Beamish et al., 2010).

## Research on Coteaching Models

Studies of coteaching across early childhood, elementary, and secondary settings reveal huge variability in how it is implemented and whether it is successful. In a review of 23 quantitative and qualitative studies of coteaching, Weiss and Lloyd (2002) identified that the important components of successful coteaching include the teacher's attitudes, sufficient planning time, voluntary participation, mutual respect, administrative support, and a shared philosophy of instruction. They also concluded that research on its efficacy was insufficient. Most of the research on coteaching has been qualitative and focused on understanding how this partnership works and the factors that seem to be associated with effectiveness.

Scruggs, Mastropieri, and McDuffie (2007) completed a systematic review of the qualitative research on coteaching. The goal of their metasynthesis was to integrate themes and insights from studies that represented virtually all qualitative research on coteaching to date. Their report described several benefits for students with and without disabilities. For example, the teacher and specialist partnership provides a social model of collaboration for students without disabilities, encouraging their cooperation with and support of other students, and students with disabilities receive additional attention and support in the classroom. As another form of cooperative learning, peer mediation and peer support have been successfully implemented in cotaught classrooms.

## Coteaching to Support At-Risk Students

In addition to services for students who have individualized education programs (IEPs), occupational therapists provide supports and develop accommodations for learners who struggle to learn the curriculum through Response to Intervention (RtI). In recent years, schools have established systems for identifying at-risk students who are struggling to learn but do not have an educational diagnosis or qualify for a special education program. The goal of RtI is to prevent academic failure and reduce the number of students who move into special education. The RtI model emphasizes proactive instruction and intervention, ongoing assessment, and data-based decision making (Murawski & Hughes, 2009). Occupational therapists serving on school teams can prevent the need for at-risk students to be provided with an IEP and to receive a more intensive level of service. The RtI model requires the same level of collaboration and interaction among school professionals as the IEP process. Partnerships in which the occupational therapist and teacher together collect data on student progress, review the data, and plan instruction with embedded interventions are needed for RtI models to effectively support at-risk learners.

We evaluated the effects of one such partnership, a handwriting and writing program called Write Start, that was cotaught by teachers and an occupational therapist and addressed handwriting legibility, handwriting speed, writing fluency, and written expression in first-grade students with diverse learning needs.

## Research Questions

The research questions were as follows:

1. Do students improve significantly in handwriting legibility, speed, writing fluency, and written expression immediately and at 6 mo following the Write Start program?
2. Do groups of students categorized by baseline handwriting legibility demonstrate differences in handwriting and writing progress immediately and at 6 mo following the Write Start program?

## Method

### *Research Design*

This prospective, one-group, pretest–posttest design compared the effects of a handwriting and writing program on three different levels of learners. Measures of handwriting and writing were administered at pretest, posttest, and 6-mo follow-up. Two first-grade classrooms in a midwestern U.S. city were selected to participate. This study was approved by the Ohio State University Institutional Review Board.

### *Sample*

Each of the two first-grade classrooms selected to participate had two or more students with IEPs. The parents were informed about the study at the start of the school year during student orientation and completed consent forms at the time of the teachers' initial assessment.

Information about which students had IEPs and about their initial academic testing was provided by the teachers. A total of 39 students (21 boys, 18 girls) received permission to enter the study. The exclusion criteria for our sample were cognitive level on academic testing <70% or severe visual or hearing loss. One child with Down syndrome was excluded from the analysis because his cognitive level did not meet our criterion; however, this child participated in the program. Six students had IEPs, a proportion similar to those among students in the district and in the metropolitan area.

### Write Start Intervention

An occupational therapist, classroom teacher, and intervention specialist implemented the Write Start program in the autumn of the first-grade year. The Write Start intervention had explicit goals to prevent handwriting problems and promote fluent writing in students of all ability levels using an evidence-based approach (see Case-Smith, Holland, & Bishop, 2011). The cotaught program involved 45-min sessions implemented twice a week for 12 wk (24 sessions total). Two types of coteaching—station teaching and team teaching (Cook & Friend, 1995)—were implemented. In *station teaching,* the coteachers created and coordinated activities for small groups of students. High- and low-performing students were selected for each group (see Tanta, Deitz, White, & Billingsley, 2005). The students rotated through the different stations while the teachers and therapists managed their stations. In *team teaching,* the teacher and therapist alternated in delivering the instruction; they coordinated who led instruction on the basis of their expertise and the content.

Each week, the teachers and occupational therapist met to plan that week's handwriting and writing sessions for both classrooms. They first reviewed students' progress using handwriting samples from the previous week. After discussing individual and overall class performance, they selected activities and strategies for the coming week, including adaptations and supports for individual students. Examples of individualized adaptations and supports for writing included highlighted paper, pencil grips, three-tone paper, raised-lined paper, and slant boards. Examples of accommodations for behavior included weights held in laps, sensory breaks, and additional adult cueing.

The first and second weekly sessions had a specific and consistent format. In Session 1, the occupational therapist instructed the students in writing two or three letters, and the students practiced each letter repeatedly. Using motor learning concepts, the teachers and occupational therapist modeled letter formation and provided simple, consistent verbal and visual cues and specific descriptive feedback during the students' practice. Then the students rotated in small groups to stations in which they participated in activities to promote (1) motor planning, sensory feedback, and manipulation; (2) visual–motor integration; and (3) memory of correct letter formation. Most of the activities used multisensory strategies for learning letter formation. Using strategies developed by Graham et al. (2000) and Harris et al. (2006), the teacher and occupational therapist asked students to evaluate their own work and promoted peer modeling and feedback by pairing students.

In Session 2, the therapist reviewed the letters that were taught in Session 1, the students copied a sentence as a writing sample, and then the students spent 20–30 min writing stories or an assignment. In the final period of Session 2, called the "writing workshop," the teacher gave mini-lessons on a writing convention or concept, the students were allowed periods of independent writing, the teacher and occupational therapist conferred with students about their writing, and the students were encouraged to share their writing with each other (e.g., read each others' writing in the "share chairs"; see Harris et al., 2006). The teacher emphasized good handwriting during the writing workshop using the terms introduced to the students during the handwriting instruction. At the end of the program, the students "published" their stories, necessitating that they edit their stories to make them readable to others.

### Measures

*Intervention Fidelity.* A fidelity measure for the Write Start program was developed using the core principles to define expected therapist and teacher behaviors and child responses (Case-Smith, Holland, & Bishop, 2011). Each instructional element was scored as performance with *complete consistency, partial consistency,* or *inconsistency.* The reliability of the fidelity instrument was established the previous year (Case-Smith, Holland, & Bishop, 2011). Graduate assistants administered the fidelity measure in 18 of the 24 Write Start sessions. In addition, Jane Case-Smith interviewed the teachers and occupational therapist at the end of the program to gather qualitative data about their coteaching experience.

*Evaluation Tool of Children's Handwriting–Manuscript.* Handwriting legibility and speed were assessed using the ETCH–M. The analyzed ETCH–M sections included lower- and uppercase alphabet legibility and lower- and uppercase alphabet speed. Percentage scores were computed for number of legible letters when writing the alphabet. Speed scores were the number of seconds the child took to write the alphabet letters. The ETCH–M demonstrated fair test–retest reliability for letter legibility

($r$ = .77) and word legibility ($r$ = .71) when first- and second-grade students were tested 1 wk apart (Diekema, Deitz, & Amundson, 1998). Feder, Majnemer, Bourbonnais, Blayney, and Morin (2007) examined the validity of the ETCH–M and found that teachers' ratings of handwriting correlated with ETCH–M scores.

Graduate research assistants administered the ETCH–M individually to students. After students completed the test's writing samples, the ETCH–M protocols were copied and blinded for scoring. Using the manual's criteria, two evaluators independently scored each ETCH–M, and the scores were then compared to determine the final legibility percentages.

*Woodcock–Johnson Fluency and Writing Samples.* Writing performance was measured using the Writing Fluency and Writing Samples subtests of the Woodcock–Johnson III Tests of Achievement (WJIII; McGrew, Schrank, & Woodcock, 2007; Woodcock, McGrew, & Mather, 2007). The WJIII is a widely used, well-developed test of academic achievement that was recently normed on a sample of 8,782 participants. Reliability for Writing Fluency and for Writing Samples is $r$ = .89 for 6-yr-olds. Interrater reliability of the Writing Samples subtest (unchanged from the revised to the third edition) was .90 for the standardization sample (McGrew et al., 2007).

In the Writing Fluency test, students were instructed to compose sentences from three words written beside a picture. The test requires minimal idea generation, but the child must link words in a complete sentence under a time constraint. Students who did not produce three grammatical sentences within 2 min were told to stop. Those who produced three grammatical sentences were allowed to continue for 7 min. One point was awarded for each grammatical sentence using all the written words without modification. In the Writing Samples test, the student wrote a meaningful sentence for a given purpose (a picture). The test requires retrieval of word meaning and syntactic information. The Writing Samples test, compared with the Writing Fluency test, is a more distal outcome of the Write Start program. Each completed form was blinded for scoring. Raw scores were used in the analysis.

The students were evaluated three times—at baseline, 1 wk, and 6 mo after the intervention. Graduate research assistants evaluated the students individually in a quiet space. The evaluators were blinded to time and group when scoring the pre- and posttests; they were blinded to group only when scoring the follow-up tests.

## Procedures

We grouped the students by initial legibility level using their pretest ETCH–M lowercase alphabet legibility score. We also checked this score using their first handwriting sample score to ensure that the ETCH–M was an accurate representation of the students' handwriting performance. The groups were defined as follows: low performing, <50% legibility; average performing, 50%–80% legibility; and high performing, >80% legibility. The characteristics of each group are presented in Table 1.

## Data Analysis

We compared the pretest, posttest, and follow-up scores for the three groups and three time points using repeated-measures analysis of variance (ANOVA). 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. A Bonferroni adjustment was made for multiple comparisons within the two categories of outcomes measures (four ETCH–M measures and two WJIII raw scores). The difference in scores from pre- to posttraining and posttraining to follow-up was tested for group differences using a one-way ANOVA. Post hoc pairwise comparisons of the groups via Tukey's method were completed for the tests that demonstrated significant differences (Group × Time). All analyses were performed using IBM SPSS Statistics (Version 19.0; IBM Corporation, Somers, NY).

**Table 1. Handwriting Scores on the Evaluation Tool of Children's Handwriting–Manuscript, by Baseline Legibility Level**

| | Group, *M (SD)* | | |
|---|---|---|---|
| Subscale and Time | Low Performing | Average Performing | High Performing |
| Lowercase alphabet legibility, % | | | |
| Pretest | 41.5 (4.0) | 59.1 (3.4) | 85.9 (4.2) |
| Posttest | 76.5 (2.6) | 88.3 (2.2) | 97.3 (2.7) |
| Follow-up | 78.5 (2.9) | 88.9 (2.5) | 98.4 (3.0) |
| Lowercase alphabet speed, s | | | |
| Pretest | 208.0 (29.1) | 255.1 (24.9) | 148.5 (30.5) |
| Posttest | 111.1 (9.8) | 92.5 (8.4) | 61.5 (10.3) |
| Follow-up | 97.8 (10.2) | 83.7 (8.7) | 61.2 (10.7) |
| Uppercase alphabet legibility, % | | | |
| Pretest | 51.5 (5.3) | 75.3 (4.5) | 88.6 (5.5) |
| Posttest | 65.5 (4.4) | 76.4 (3.8) | 90.0 (4.6) |
| Follow-up | 69.7 (4.1) | 85.6 (3.5) | 93.7 (4.3) |
| Uppercase alphabet speed, s | | | |
| Pretest | 210.0 (29.1) | 203.7 (24.9) | 171.5 (30.5) |
| Posttest | 120.9 (12.7) | 113.5 (10.9) | 92.8 (13.3) |
| Follow-up | 101.8 (9.8) | 100.3 (8.4) | 81.4 (10.2) |

*Note.* Students were grouped on the basis of baseline handwriting legibility level as follows: low-performing group, <50% legibility; average-performing group, 50%–80% legibility; and high-performing group, >80% legibility. *M* = mean, *SD* = standard deviation.

## Findings

Two students moved during the school year; therefore, 36 students (mean age = 77.4 mo; range = 72–88 mo) were included in the final analysis. The groups, as defined by pretest scores, were composed as follows:

- Low-performing group (<50% legibility), 11 students (9 boys, 2 girls; 3 with IEPs)
- Average-performing group (50%–80% legibility), 15 students (8 boys, 7 girls; 1 with an IEP)
- High-performing group (>80% legibility), 10 students (2 boys, 8 girls; 1 with an IEP).

### *Intervention Fidelity*

Intervention fidelity was very high and was similar across the two classrooms. For a sample of 18 sessions, the protocol was implemented with 93.5% complete consistency for Classroom 1 and 94% complete consistency for Classroom 2. Student participation was also consistent, and the evaluators judged the students to be highly engaged during the sessions. Data from the interview with the teachers and occupational therapist were used to assist in interpreting the findings (see Discussion).

### *Handwriting Legibility and Speed*

Because the Write Start program taught the student lowercase letters, our analysis focused on lowercase alphabet legibility. As a group, the students improved by 27 percentage points in lowercase handwriting legibility (from 62% legibility to 89% legibility), and this improvement was highly significant, $F(2, 66) = 95.9$, $p < .001$, $\eta^2 = .74$. They also improved significantly in handwriting speed for writing the lowercase alphabet; the mean speed decreased by 122 s, from 203.9 s to 80.9 s, $F(2, 66) = 52.1$, $p < .001$, $\eta^2 = .61$. In the uppercase alphabet, the students also made significant progress in legibility, $F(2, 66) = 6.7$, $p = .002$, $\eta^2 = .17$, improving by 11.2 percentage points, and in speed, $F(2, 66) = 31.2$, $p < .001$, $\eta^2 = .49$, improving by 97.1 s. Uppercase alphabet was not emphasized in the program, and it is not surprising that the improvement was less substantial (see Table 1).

### *Writing Fluency and Written Expression*

The students also made significant gains in writing fluency and written expression (Table 2). For all students, mean scores for Writing Fluency improved by 6.7 points, from 1.2 to 7.9, a significant gain, $F(2, 66) = 45.6$, $p < .001$, $\eta^2 = .58$. Writing Samples, a measure of written expression, was considered to be an indirect outcome of the Write Start program because writing ability was not the emphasis of the program. Writing Samples mean scores improved significantly from pretest (7.6) to follow-up (10.7), $F(2, 66) = 46.9$, $p < .001$, $\eta^2 = .59$.

### *Differences in Performance Among Students Grouped by Baseline Legibility*

When the students were grouped by baseline legibility, they differed in lowercase alphabet legibility from pretest to follow-up, demonstrating an interaction effect for Time and Group, $F(4, 66) = 6.79$, $p < .001$. The differences in pretest, posttest, and follow-up lowercase legibility were analyzed using Tukey's post hoc pairwise group comparisons. The low-performing group showed significantly more improvement than the high-performing group ($p < .001$), and the average-performing group showed significantly more improvement than the high-performing group ($p = .002$). The low- and average-performing groups did not exhibit different levels of improvement. Figure 1 displays group mean scores across time points.

Thus, more substantial improvement was seen in the low-performing group (37% improvement in legibility) than in the high-performing group (13% improvement). The average-performing group also made significantly more improvement in lowercase legibility (30%) compared with the high-performing group. This difference in amount of improvement is attributable both to a ceiling effect for the high-performing group and to the highly significant gains by the two lower performing groups. Group × Time interaction was not significant for lowercase alphabet speed, $F(4, 66) = 2.4$, $p = .086$; uppercase alphabet legibility, $F(4, 66) = 1.2$, $p = .304$; or uppercase alphabet speed, $F(4, 66) = 0.07$, $p = .960$), indicating the gains were similar across groups.

**Table 2. Writing Fluency and Writing Samples Scores on the Woodcock–Johnson III Tests of Achievement, by Baseline Legibility Level**

| | Group, *M (SD)* | | |
|---|---|---|---|
| Subtest and Time | Low Performing | Average Performing | High Performing |
| Writing Fluency raw scores | | | |
| Pretest | 0.2 (0.5) | 0.9 (0.4) | 2.5 (0.6) |
| Posttest | 2.1 (1.3) | 5.3 (1.1) | 5.9 (1.4) |
| Follow-up | 3.8 (1.3) | 8.5 (1.1) | 11.3 (1.4) |
| Writing Samples raw scores | | | |
| Pretest | 5.4 (0.6) | 7.3 (0.5) | 10.2 (0.6) |
| Posttest | 8.0 (0.5) | 8.9 (0.5) | 11.3 (0.6) |
| Follow-up | 9.9 (0.5) | 10.5 (0.4) | 11.7 (0.5) |

*Note.* Students were grouped on the basis of baseline handwriting legibility level as follows: low-performing group, <50% legibility; average-performing group, 50%–80% legibility; and high-performing group, >80% legibility. *M* = mean, *SD* = standard deviation.

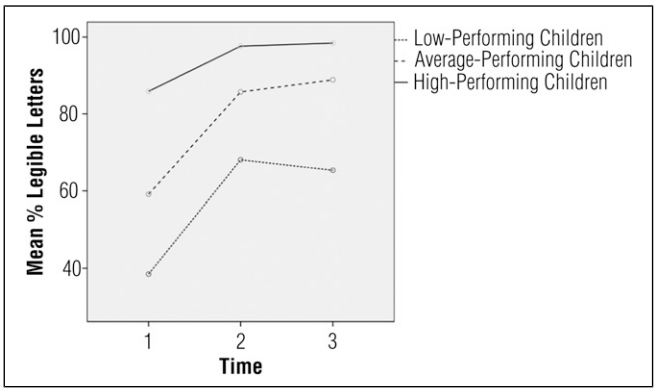


**Figure 1. Mean lowercase alphabet legibility scores on the Evaluation Tool of Children's Handwriting–Manuscript. Time 1 = preintervention; Time 2 = postintervention; Time 3 = follow-up.**

Differences in progress by group approached significance when Writing Fluency raw scores were compared, $F(4, 66) = 2.7$, $p = .041$. The low-performing group improved by 3.6 points, the average-performing group by 7.6 points, and the high-performing group by 8.8 points. Figure 2 suggests that the average- and high-performing groups made more progress than the low-performing group; however, applying Bonferroni correction ($p < .025$), the difference was not significant. Writing Sample scores did not differ in Group × Time comparisons; the interaction for Group × Time was not significant, $F(2, 66) = 1.4$, $p = .230$. The high-performing group improved by only 1.6 points, suggesting a ceiling effect; 6 students in the high-performing group scored the highest raw score (12) for Writing Samples at both posttest and follow-up.

## Discussion

This study examined the progress made when a diverse set of learners, including students who struggled with handwriting, participated in a cotaught handwriting and writing program. Although inclusive services embedded in the classroom have been advocated (Odom & Wolery, 2003), the research on inclusive occupational therapy services is minimal (e.g., Bazyk et al., 2009). Research on handwriting interventions has examined the effects of one-on-one (Graham, Harris, & Mason, 2005; Zwicker & Hadwin, 2009) and small-group (Berninger et al., 1997; Weintraub et al., 2009) models. We implemented the Write Start program with the entire first-grade class, embedding additional supports and accommodations into each session. In this classroom-embedded model, we used station teaching, repeated practice, frequent and immediate adult feedback, self-evaluation, and peer modeling and support. These methods allowed the occupational therapist and teachers to meet the needs of individual students and to accommodate different learning styles.

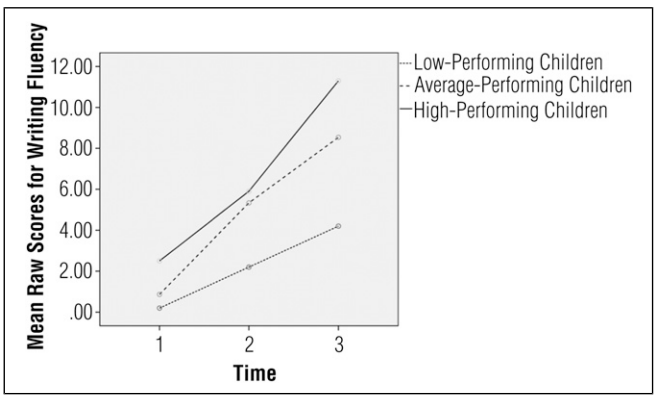


**Figure 2. Mean Writing Fluency scores on the Woodcock–Johnson III Tests of Achievement. Time 1 = preintervention; Time 2 = postintervention; Time 3 = follow-up.**

Giangreco (2007) described a multiple-level curriculum in which teachers modified the curriculum to enable students with disabilities to participate in the regular classroom. The components of this multiple-level curriculum include instruction planning specifically to meet different learning needs, shared activities to foster peer modeling and support, and individualized activities for students with disabilities. Providing a multiple-level curriculum requires a team that consistently reviews students' progress and plans specific modifications to the curriculum and classroom activities (Giangreco, 2007).

Coteaching provides a structure for ongoing collaboration between teachers and therapists to review student progress and plan instruction (Cook & Friend, 1995). We evaluated the feasibility and effectiveness of a cotaught handwriting and writing program. The fidelity of the program was high, suggesting its feasibility. Our model of coteaching required an hour a week to review students' progress and plan the sessions. The importance of this planning meeting is documented in the literature (Scruggs et al., 2007) and seemed to be essential to the success of the program.

The teachers and occupational therapist were enthusiastic about the model and revealed in the final interview that coteaching required flexibility, willingness to partner, openness to others' ideas, and time to plan. When asked about the benefits of the model, the teachers and occupational therapist noted that students received more attention and individualized instruction, interventions were easy to implement and monitor, and students learned about collaboration and cooperation from the modeling of the teachers and occupational therapist. The teachers and occupational therapist also reported that they gained skills from working together. In particular, the teachers learned strategies for teaching handwriting, and the occupational therapist learned about the first-grade curriculum and behavioral management of a classroom. Compared with traditional instruction, the

teachers who participated in Write Start felt that the handwriting goals were generalized more readily into the classroom instruction and that handwriting instruction was better integrated into the writing curriculum.

The goal of this study was to develop and evaluate a model of service delivery that would enable occupational therapists to provide services to at-risk and struggling students before they were placed on IEPs and referred for occupational therapy services. A substantial proportion of students struggle with handwriting (Cahill, 2009; Graham et al., 2008) and can benefit from additional supports but have no or limited access to occupational therapy services. To determine the effect of the Write Start program on children who were struggling with handwriting or had illegible handwriting, we compared the progress of low-, average-, and high-performing students as determined by baseline legibility. Students with low initial handwriting legibility scores made the greatest progress, improving 34.6% in 12 wk. In a similar study, Zwicker and Hadwin (2009) reported that the students in their handwriting interventions improved just over 14% in 10 wk. In a study by Case-Smith (2002), the students improved 14% in legibility following 9 mo of regular occupational therapy services. The low-performing group's gains in the current study were relatively substantial and were retained at year-end testing.

The second primary variable of interest was writing fluency; our hypothesis was that once handwriting is automatic, students develop fluency and can focus on content and composition. Fluency was measured using lowercase alphabet speed and the Writing Fluency scale. These scores improved substantially for students at all performance levels. Handwriting speed improved 87.3 s for the high-performing group and 110.2 s for the low-performing group. The average-performing group improved 171.4 s for writing the alphabet, which, combined with their follow-up legibility scores (89%), indicates that they had become functional handwriters. All groups improved in writing fluency, making substantial gains in the follow-up period. Their improvement after the program ended suggests that the students' handwriting had become automatic, allowing them to focus on writing and mastering writing fluency.

Students of all performance levels seemed to benefit from the Write Start program. The students who initially were struggling in handwriting improved the most in legibility, and the students who initially had good legibility made substantial gains in writing fluency. Therefore, the program was able to meet the needs of diverse learners in the natural context of the first-grade classroom. Although the model required three adults, including an occupational therapist, it is probable that the same amount of time would be needed for the teacher to provide handwriting instruction to the class and for the occupational therapist to provide individualized services to children with poor handwriting.

## Limitations

This study's limitations include the small sample size, lack of a control group, and partial blinding. Two first-grade classrooms in a suburban school district were included; broader representation of socioeconomic levels would improve generalizability of the findings. This study did not use a comparison group but focused on comparing students at different ability levels who participated in the same program. Evaluation was only partially blinded (i.e., blinded at the time of scoring but not at test administration). The ETCH–M handwriting samples were independently scored by two raters to improve scoring accuracy.

## Implications for Occupational Therapy Practice

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

- Handwriting instruction for first-grade students that includes adult modeling of letter formation, use of consistent visual and verbal cues, repeated practice with immediate adult feedback, peer modeling and support, and self-evaluation results in significant gains in legibility, speed, and fluency.
- Integrating occupational therapy handwriting interventions into the classroom using a coteaching model allows students with poor handwriting to receive services while remaining in their learning environment and promotes handwriting performance among all students.
- First-grade students across ability levels may benefit when coteaching teams of occupational therapists and teachers collaboratively plan and implement handwriting instruction that is linked to students' writing instruction.

## Conclusion

The first-grade students who participated in the Write Start cotaught handwriting and writing program with classroom-embedded occupational therapy services made significant progress in handwriting legibility, speed, and writing fluency that was retained at 6-mo follow-up. Students who demonstrated low baseline legibility made

progress in handwriting and writing similar to that of students who demonstrated high baseline legibility.

As a model for inclusive, classroom-embedded occupational therapy services, Write Start appears to benefit students at risk for handwriting and writing problems and may prevent later handwriting problems. By supporting the development of writing fluency, this model enhances young children's literacy competency. ▲

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