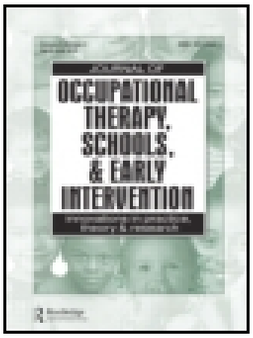

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Effectiveness of a Handwriting Curriculum in Kindergarten Classrooms

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ABSTRACT
Handwriting is still critical to student success in the classroom; however, schools have been de-emphasizing formal handwriting instruction. This study evaluated the effect of the *Size Matters Handwriting Program* on handwriting legibility and visual-motor skills among kindergarten students in general education classrooms. A two-group time series design was used with two classrooms that received the *Size Matters Handwriting Program* (n = 35) and a control classroom (n = 16). Both groups made statistically significant gains in handwriting legibility, as would be expected of kindergarten students (Intervention: p = <0.001; Control: p = <0.001). However, students in the intervention group did not demonstrate statistically significantly greater gains in handwriting legibility or visual-motor integration skills compared to students in the control group (p > .05). Handwriting improvement was neither linear (p = < .006) nor associated (r < .09-.19) with visual-motor skills.

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Curriculum; education; effective instruction; handwriting; students

Background

Handwriting is a primary component of student participation and success in schools, making it a vital student occupation. Children generally begin to practice pre-handwriting as toddlers with scribbling and then making shapes (Feder & Majnemer, 2007; Puranik & Lonigan, 2011). When children have developed the underlying readiness skills, the drawing of shapes evolves into letters and then words that gradually increase in legibility and speed (Feder & Majnemer, 2007; Puranik & Lonigan, 2011). Handwriting develops sequentially with children demonstrating knowledge of linearity (i.e., writing organized in a straight line), segmentation (i.e., letters separated by spaces), and the presence of simple units (i.e., abstract markings) before directionality (i.e., writing left to right), symbol shapes (i.e., language specific letters), and spacing between words (Puranik & Lonigan, 2011). Handwriting should be taught in a sequential manner based on a child's skill level (Fancher, Priestley-Hopkins, & Jeffries, 2018;Feder & Majnemer, 2007). Likewise, the approach used to teach handwriting may differ based on a child's age (Zwicker & Hadwin, 2009).

The quality of a person's handwriting is characterized by legibility and speed (Schwellnus et al., 2012). Legibility consists of accurate letter formation, spacing, letter size, and placement (Mackay, McCluskey, & Mayes, 2010). Handwriting speed is the actual speed of written output, quantified as letters or words per minute (Schwellnus et al., 2012). Legibility and

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speed are both important factors in handwriting since both are critical for effectively communicating in written form (Pfeiffer, Rai, Murray, & Brusilovskiy, 2015; Shaw, 2011). However, handwriting legibility should be addressed first, as handwriting speed is believed to increase with handwriting practice (Hoy, Egan, & Feder, 2011).

Historically, handwriting, like reading, science, and math, has been formally taught to school-aged children. Traditionally, handwriting instruction has occurred in the first and second grades of elementary school (Asher, 2006; Case-Smith, Weaver, & Holland, 2014). However, in recent years, handwriting instruction in elementary schools has, in a large part, been pushed aside (Asher, 2006; Pfeiffer, Rai, et al., 2015; Shaw, 2011). The impetus for this change appeared to be the increased curriculum demands in core content areas of reading, math, and science put forth by the No Child Left Behind Act and the related student achievement testing, such as the Common Core State Standards (Klein, 2015; No Child Left Behind, 2002). Since the No Child Left Behind Act (2002) took effect, the length of the school day has not increased, but more time in the day has been dedicated to reading, math, and science (Asher & Estes, 2016). Furthermore, the handwriting instruction provided is more frequently implemented without the use of a published handwriting curriculum (Asher & Estes, 2016; Pfeiffer, Rai, et al., 2015). Instead, teachers often use a variety of strategies and materials that they collate together, which can cause inconsistencies and gaps in handwriting instruction between classrooms and grades (Asher, 2006). This increases the risk of children developing poor quality of handwriting (Asher, 2006; Hoy et al., 2011; Kaiser, Albaret, & Doudin, 2011; Pfeiffer, Rai, et al., 2015). It also results in elementary school-age children being expected to complete increasingly complex or lengthy written assignments without many of them having acquired the basic skills necessary for quality handwriting (Hoy et al., 2011).

There is a growing body of literature suggesting that using a published handwriting curriculum is important to children's success when teaching handwriting (Engel, Lillie, Zurawski, & Travers, 2018). Furthermore, the critical components that should be included in these curriculums to be most effective have been investigated (Hoy et al., 2011; Kaiser et al., 2011; Mackay et al., 2010; Pfeiffer, Rai, et al., 2015). First, the intensity of classroom-based handwriting instruction was found to be important to maximize the development of children's handwriting skills (Hoy et al., 2011; Kaiser et al., 2011; Pfeiffer, Rai, et al., 2015). The ideal intensity was found as being 10 weeks of handwriting instruction provided at a frequency of twice a week (Hoy et al., 2011). Second, classroom handwriting curriculum should start with explicit instruction in letter legibility, include repetitive practice of letter and word writing with adult feedback, and plan for gradual fading of adult support as students' skill levels increase (Hoy et al., 2011; Kaiser et al., 2011). Finally, **a** handwriting curriculum that includes self-assessment and verbal feedback results in greater improvements in children's handwriting legibility and speed (Fancher et al., 2018; Kaiser et al., 2011; Lust & Donica, 2011; Mackay et al., 2010).

A variety of published handwriting curriculums exist, including *D'Nealian* (Scott Foresman & Company, 1978), *Handwriting Without Tears* (Olsen, 1999), *Sunform* (Sundberg, 1994), *Zaner-Bloser Handwriting* (Zaner-Bloser Educational Publishers, 1993), and the more recently published, *Size Matters Handwriting Program* (Moskowitz, 2009). After an extensive review of published handwriting curriculum, *Size Matters Handwriting Program* (SMHP; Moskowitz, 2009) was identified as the program that includes most of the components of effective handwriting curriculums. SMHP utilizes explicit teaching instructions and practice, self-

assessment and correction, and verbal feedback with visual motivators (Pfeiffer, Rai, et al., 2015). SMHP supports the development of handwriting skills in a linear sequence with early instruction centered around accurate formation of letters, placement of letters on the writing lines, and spacing between letters (Moskowitz, 2009). Research has shown that the SMHP can be an effective curriculum for improving handwriting skills and can be embedded into classroom instruction (Pfeiffer, Rai, et al., 2015; Zylstra & Pfeiffer, 2016).

A Pennsylvania school district where handwriting was taught in kindergarten without the use of a published handwriting curriculum agreed to participate in this study. The intent was to determine whether SMHP would result in greater handwriting legibility gains and visual-motor skills acquisition than the standard classroom teaching methods used previously by the district's kindergarten teachers. Specifically, this study aimed to:

(1) Evaluate the effectiveness of embedding a published handwriting curriculum into classroom instruction compared to the standard classroom instruction methods used on handwriting legibility.
(2) Evaluate the effectiveness of embedding a published handwriting curriculum into classroom instruction compared to the standard classroom instruction methods currently used on visual-motor integration skill acquisition.

It was hypothesized that students who were taught handwriting using the SMHP curriculum would demonstrate significantly ($p < .05$) greater gains in handwriting legibility and visual-motor integration skills when compared to students taught with the standard classroom handwriting instruction.

Method

Research Design

A two-group time series design was utilized to evaluate the effect of embedding the SMHP into classroom instruction on handwriting legibility and visual-motor integration skill acquisition among kindergarten students.

Participants

Fifty-one kindergarten students from three general education classrooms at one public elementary school in a large school district in south central Pennsylvania participated in this study. The classroom teachers of two kindergarten classrooms began to use the SMHP curriculum to teach handwriting in their classrooms instead of the standard classroom handwriting instruction they had previously used. As is customary in that school district, the other kindergarten teacher was asked to continue to teach handwriting using a variety of strategies without the use of a published handwriting curriculum. To be included in the study, students in these three classrooms had to have written informed consent from their parent or guardian and receive the majority of their instruction within the general education classroom. Students were excluded from the study if they received school-based occupational therapy services for handwriting. This study received Institutional Review Board approval and formal approval from school district administrators.

Data Collection

Demographic Information

Students' basic demographic information (i.e., age, date of birth, sex, and race) was obtained from the school district's electronic database (Table 1). In addition, the school district administration provided information about the percentage of students in each classroom who received free/reduced lunch as an estimate of socio-economic status of the children (Table 2). Classroom rosters were also used to determine the percentage of eligible students who participated in the study (Table 2). Each classroom teacher also completed a demographic and professional information form providing their age, sex, race, number of years teaching, number of years teaching kindergarten, and previously used published handwriting curriculums (Table 2). Teacher demographic data was collected to ascertain whether the teachers' background and experience were similar as these are potential confounding variables.

Table 1. Characteristics of participating children.

	Intervention Classrooms (n = 35)			Control Classroom (n = 16)			
Characteristic	Frequency (percentage)	M	(SD)	Frequency (percentage)	M	(SD)	*p*-value
Sex							
Male	20 (57)			10 (63)			0.36^
Female	15 (43)			6 (38)			0.35^
Age (in months)		66.43	(4.29)		68.06	(3.4)	0.15+
Race							
White	30 (86)			12 (75)			0.6^
Black or African American	0 (0)			1 (6)			0.75^
Asian	0 (0)			1 (6)			0.75^
More than one race	3 (9)			0 (0)			>0.99^
Other*	2 (6)			2 (13)			>0.99^
Readiness to print	18 (51)			14 (88)			0.002^

Key: ^ = Chi-square test; + = Welch's t-test
Note: *All participating children listed under "Other" reported being both White and Hispanic
$p < .05$

Table 2. Characteristics of participating teachers and their classrooms.

	Teachers (n = 3)		
Characteristics	*IC1*	*IC2*	*CC*
Sex			
Male	0	0	0
Female	1	1	1
Age (in years)	31	34	31
Race			
White	1	1	1
Teaching experience (in years)	6	14	8
Teaching kindergarten (in years)	6	2	3
Previously used published handwriting curriculum			
Yes	0	1	0
No	1	0	1
Free/Reduced Lunch*	52.38%	42.86%	40%
Eligible students who participated in the study	94.44%	94.74%	80%

Key: *IC1* = Intervention Classroom 1; *IC2* = Intervention Classroom 2; *CC* = Control Classroom
Note: *Numbers reported include all students in each classroom and not specific to participants in the study

Evaluation Tool of Children's Handwriting- Manuscript (ETCH-M)

The ETCH-M is a criterion-referenced assessment of handwriting legibility and speed (Amundson, 1995). It includes six tasks that focus on alphabet and numeric writing, near-point and far-point copying, dictation, and sentence composition. It is intended for use with students in grades one through six (Amundson, 1995). Only the tasks appropriate for kindergarten-aged students (i.e., alphabet writing in lowercase and uppercase) were used to assess change in handwriting legibility as part of this study. The alphabet writing subtests consist of the 26 alphabet letters, which are given a score of legible or illegible based on scoring criteria. A higher score indicates better handwriting skills. Only legibility was assessed, since at that age handwriting speed is not a critical factor (Pfeiffer, Rai, et al., 2015; Schwellnus et al., 2012). The ETCH-M alphabet writing task requires students to write the alphabet sequentially from memory for lowercase and uppercase letters. This was modified for the kindergarten students to avoid confounding alphabet memorization and handwriting legibility with students who are still learning their alphabet. The researcher verbally stated twice the name of each letter of the alphabet in sequential order. The alphabet writing task was administered by the same researcher in small groups of four to seven students in the school library at three intervals during the school year. Students completed all assessments at a consistent time during the school day. The ETCH-M has a test-retest reliability ranging from .63 to .77 and an inter-rater reliability of .84 for experienced raters (Feder & Majnemer, 2003).

The Beery-Buktenica Developmental Test of Visual-Motor Integration 6th Ed. (VMI)

The VMI is a standardized, norm-referenced assessment of visual-motor integration skills comprised of the full form test and two supplemental tests: Beery VMI, Visual Perception, and Motor Coordination (Beery & Beery, 2010). It is intended for use with individuals aged 2 through 100. Each test consists of 30 items, which are given a score of correct or incorrect based on scoring criteria. A higher score indicates better skill development. In addition, the ability to copy the first nine forms of the VMI is often considered to be an indicator of handwriting readiness (Beery & Beery, 2010; Daly, Kelley, & Krauss, 2003). The VMI The full form test and the two supplemental tests of the VMI were administered classroom-wide at three intervals during the school year with all directions given by the same researcher and support provided by the classroom teacher and classroom aide. Students completed all assessments at a consistent time during the school day. The VMI tests have test-retest reliability ranging from .84 to .88 (Beery & Beery, 2010). The VMI tests have an inter-rater reliability ranging from .93 to .98 (Beery & Beery, 2010). The minimally detectable difference among kindergarten students ranged from 2.55 to 2.96 (Shirley Ryan Abilitylab, 2016).

Inter-scorer Reliability for the ETCH-M and VMI

The researcher scored all assessments with 10% of assessments also scored by a second rater to identify potential scorer bias. The second rater received training on scoring the ETCH-M and VMI from the researcher and was blinded to classroom allocation for all assessments. The researcher and second rater met two separate times to compare scoring of various data points. The inter-rater reliability for this study was found to be .85 for the ETCH-M and .98 for the VMI.

Semi-structured group interview. All three kindergarten teachers participated in a 20-minute group interview at the conclusion of the school year. The interview consisted of 8 open-ended questions (Appendix A). The questions focused on changes in their perceptions of handwriting instruction, impressions of the importance of handwriting and implementation of a published handwriting curriculum, and the handwriting curriculum's effectiveness on improving handwriting legibility. The researcher took detailed handwritten notes during the interview.

Intervention

The two teachers in the intervention classrooms implemented the SMHP using the teacher's manual that includes directions for daily handwriting lesson plans, key concepts, and suggestions for verbal cues to utilize while teaching. Each student in the intervention classrooms received the SMHP student workbook. The control classroom teacher taught handwriting by using a variety of strategies without the use of a published handwriting curriculum or knowledge in the SMHP. These strategies included visual demonstration, verbal feedback, and time for student practice. The control classroom teacher used tracing and copying worksheets that she had compiled into workbooks for both single letters and words. All three teachers spent approximately 10–15 minutes per school day on handwriting instruction, which is more than the minimum amount identified in the literature. Classrooms were split into two groups of students that rotated every other day between the handwriting lesson and another classroom activity. This allowed for teachers to focus on a smaller group during handwriting instruction. Students received direct handwriting instruction in the classroom regardless of their participation in the program.

Fidelity of Intervention

The five components of fidelity of intervention (i.e., intervention design, training of providers, intervention delivery, receipt of intervention, and enactment of skills gained from the intervention) described by Murphy and Gutman (2012) were addressed in this study. First, the study used a manualized intervention approach, which provided a sound intervention design. Second, the intervention classroom teachers and the researcher attended a commercially available training about the SMHP consisting of three parts to ensure adequate training of providers. Part 1 consisted of the introduction, research, and key concepts. Part 2 consisted of the implementation options. Part 3 consisted of assessment and interpretation, goal writing, and progress monitoring. The intervention teachers completed the first two parts of the series. The researcher completed all three parts of the series. Third, to ensure that the intervention was delivered as planned, the researcher conducted classroom observations using a checklist to ensure the SMHP key concepts were correctly embedded and taught to students in the intervention classrooms. The control classroom teacher was observed to determine if the SMHP concepts were present in her handwriting instruction. These observations occurred three times during the school year. Fourth, to ascertain the degree to which students received the intervention, the researcher obtained attendance information from the school district. All students enrolled in the three kindergarten classrooms had a combined attendance rate of 95.11% for the school year. Finally,

enactment of skills gained from the intervention was ascertained through the outcome measures (i.e., the ETCH-M and the Beery VMI).

Data Analysis

To describe the characteristics of the students, socio-demographic information was compiled into percentages (sex, race, age, free/reduced lunch status) and a range (age). Chi-square test and a Welch's t-test were used to compare the two groups' socio-demographic information. To estimate the effectiveness of the intervention on handwriting legibility and visual-motor skill acquisition, Welch's t-test, paired t-tests and mixed ANOVAs were computed (Table 3). The Fisher Exact test was used to determine the correlation between legible handwriting and the first nine forms of the VMI. To explore the perspectives of the teachers regarding a published handwriting curriculum, the researcher's interview field notes were used to extract the main themes and ideas.

Results

Demographics

A total of 51 kindergarten students participated in this study. Table 1 provides the students' demographic characteristics. The mean ages of the students in the intervention classrooms and the control classroom were 66.43 months old and 68.06 months old respectively. There was a wide age range of students, with the youngest being 5.0 years old and the oldest being 6.5 years old at the start of the school year. More than half of students in both groups were male, with 20 (**57**%) in the intervention classrooms and 10 (63%) in the control classroom. The majority of students identified their race as white, with 30 (86%) in the intervention classrooms and 12 (75%) in the control classroom. Based on the ability to accurately copy the first nine forms of the VMI, there were 18 (51%) students in the intervention classrooms and 14 (88%) students in the control classroom who were deemed developmentally ready to print. There were no statistically significant differences when comparing demographic characteristics between students in the intervention group and students in the control group, except in terms of handwriting readiness to print (Table 1).

Table 3. Comparison in handwriting legibility between the intervention and control classrooms.

	Data Point 1 September		Data Point 2 February		Data Point 3 May		Within Group	Between Groups
ETCH	M	(SD)	M	(SD)	M	(SD)	p	p
Lower Case Copy								
IC	4.57	(4.31)	14.0	(5.05)	14.97	(4.42)	<0.001*	0.39#
CC	10.75	(5.47)	17.63	(4.15)	19.5	(3.92)	<0.001*	
Upper Case Copy								
IC	6.63	(5.97)	12.06	(5.0)	12.66	(4.78)	<0.001*	0.62#
CC	12.0	(5.15)	16.63	(3.86)	16.94	(3.68)	<0.001*	

Key: *IC* = Intervention Classrooms; *CC* = Control Classroom; *paired t-test Data Point 1 and Data Point 3; #Mixed ANOVA Data Point 1 and Data Point 3
$p < .05$

Differences in Handwriting Legibility Scores

Summaries of the handwriting legibility scores are presented for both groups in Table 3. For both lowercase and uppercase legibility, a Welch t-test showed that the groups were not statistically equivalent at baseline ($p < .0001$) with the students in the control classroom having more legible handwriting at the start of the school year. As expected in kindergarten, both groups improved significantly in terms of lowercase and uppercase legibility between the start and the end of the school year (Intervention classrooms $p = < .001$; Control classroom $p = < .001$; Table 3). For the intervention group, the majority of the improvement in legibility for both uppercase and lowercase letters occurred between September (Data Point 1) and February (Data Point 2). In fact, the improvement between September and February is statistically significantly greater than the improvement made between February and May (Data Point 3; lowercase $p = < .001$; uppercase $p = < .006$) when scores plateaued. This suggests that the majority of handwriting legibility improvement for this group occurred during the first five months of the school year. This was true but not to the same extent for the control group where improvements in handwriting legibility were more stable during the first part and second part of the school year (Table 3).

While both groups demonstrated significant improvements in handwriting legibility, the degree of improvement between the two groups was not statistically significant (lowercase $p = .39$; uppercase $p = .62$; Table 3). Thus, in this study, the use of a published handwriting curriculum did not result in statistically significantly greater handwriting legibility as was hypothesized. To determine the treatment effect from a clinical viewpoint, a further exploration of handwriting legibility changes between groups was performed. Brossard-Racine and colleagues (2012) determined that a student's handwriting was legible if 76% of the letters in a writing sample were legible. After the number of students who met this criteria of printing 76% of their letters legibly was tabulated for each data point and then compared between the two groups, it became apparent that the control group had a greater change in the number of students who met the criteria (i.e., had legible handwriting) than the intervention group by 24% and 25% respectively for lowercase and uppercase letters (Table 4).

Differences in Visual-Motor Skill Scores

Summaries of the visual-motor skill scores are presented for both groups in Table 5. While handwriting improved, visual-motor integration skills did not improve over time. In fact, paired t-tests showed that the control classroom demonstrated a statistically significant

Table 4. Comparison of number of students with legible handwriting.

	Intervention Classrooms (n = 35)				Control Classroom (n = 16)			
	Data 1 Count (%)	Data 2 Count (%)	Data 3 Count (%)	Percentage of Change	Data 1 Count (%)	Data 2 Count (%)	Data 3 Count (%)	Percentage of Change
LC	0 (0%)	6 (**17**%)	7 (20%)	20%	1 (6%)	4 (25%)	8 (50%)	44%
UC	2 (6%)	3 (9%)	2 (6%)	0%	1 (6%)	2 (13%)	5 (31%)	25%

Key: LC = lowercase copy; UC = uppercase copy

Note: Handwriting legibility was determined using the cut-off legibility value of >76% that was identified by Brossard-Racine et al. (2012)

Table 5. Comparison in visual-motor skills between the intervention and control classrooms.

	Data Point 1 September		Data Point 2 January		Data Point 3 May		Within Group	Between Groups
Beery-VMI	M	(SD)	M	(SD)	M	(SD)	p	p
Visual-Motor Integration								
IC	96.03	(9.62)	98.26	(8.11)	96.89	(7.75)	0.504*	0.14#
CC	103.44	(6.54)	102.5	(7.54)	99.19	(6.56)	0.015*	
Visual Perception								
IC	95.06	(14.61)	106.74	(12.2)	106.0	(18.3)	0.005*	0.89#
CC	108.19	(19.11)	116.5	(18.55)	118.13	(22.57)	0.001*	
Motor Coordination								
IC	85.09	(10.83)	85.46	(12.13)	84.86	(10.51)	0.902*	0.39#
CC	92.94	(8.68)	93.13	(10.74)	96.44	(8.91)	0.145*	

Key: *IC* = Intervention Classrooms; *CC* = Control Classroom; *paired t-test Data Point 1 and Data Point 3; #Mixed ANOVA Data Point 1 and Data Point 3
$p < .05$

decline in VMI scores, whereas the intervention classrooms made very minimal gains that were not statistically significant (Intervention classrooms $p = .504$; Control classroom $p = .015$; Table 5). Changes over time within both groups were within the standard error of measurement (6; Beery & Beery, 2010). Both groups improved significantly in the area of visual perception skills, as measured by the VP subtest of the VMI, between the start and the end of the school year (Intervention classrooms $p = .005$; Control classroom $p = .001$; Table 5). Whereas, both groups demonstrated minimal change in the area of motor coordination skills, as measured by the MC subtest of the VMI (Intervention classrooms $p = .902$; Control classroom $p = .145$). A mixed ANOVA determined that the degree of improvement in VMI, VP, and MC between the two groups was not statistically significant (VMI $p = .14$; VP $p = .89$; SS $p = .39$; Table 5). For the intervention group, the improvement in visual-motor skills for all three tests occurred between September (Data Point 1) and January (Data Point 2) before demonstrating a slight decline in scores in May (Data Point 3; Table 5). The control group demonstrated similar improvements in January (Data point 2), except in the area of VMI where there was a slight decline in scores.

Some literature suggests that there is an association between a child's ability to copy the first nine shapes of the VMI and handwriting legibility (Daly et al., 2003; Weil & Amundson, 1994). Correlation found weak association ($r < .09$-$.19$) between visual-motor skills and handwriting legibility, whether students' full scores for each subscale (e.g., VMI, VP and MC) or score for the first nine forms of the VMI were used, in accordance with the procedure used by Daly and colleagues (2003). In addition, the Fisher Exact test determined that there was no significant correlation ($p > .05$) between students' scores on the first nine forms of the VMI and handwriting legibility when using the 76% handwriting legibility cut-off value (Brossard-Racine et al., 2012).

Semi-Structured Group Interview

Extensive handwritten field notes were taken during the semi-structured group interview with the teachers and used to extract their perspectives on teaching handwriting and utilizing a published handwriting curriculum. All three teachers identified time as being the biggest barrier to teaching handwriting. They noted the increased academic demand in other areas

and the shortened kindergarten day as the primary time barriers. The teachers agreed that they were more focused on ensuring that daily handwriting instruction was occurring in their classrooms due to their participation in this study. The intervention classroom teachers reported that the SMHP eased the burden of lesson planning. The control classroom teacher mentioned that she felt like her students improved with the materials and lessons she used. However, she felt like she would have been a more effective teacher if she had used a published handwriting curriculum. She explained that she thought that her students might have been able to make even larger gains in their handwriting skills if she had used a published handwriting curriculum. The intervention classroom teachers stated they enjoyed the child-friendly approach of the SMHP, not only through the workbook but also through the terminology used. They also noted that using the SMHP allowed them to provide consistent handwriting instruction between the two classrooms. Both intervention classroom teachers stated that they wanted to continue implementing SMHP in the upcoming school year. In addition, the control classroom teacher showed substantial interest in receiving the SMHP training and using the curriculum with her students during the next school year.

Discussion

Handwriting Legibility

The children who received handwriting instruction through the SMHP curriculum (i.e., intervention group) and those children who received the standard classroom handwriting instruction (i.e., control group) both made statistically significant gains in handwriting legibility. This was unsurprising, as young children improve regardless of the instruction they receive (Zwicker & Hadwin, 2009). However, contrary to the findings of Pfeiffer, Rai, and colleagues (2015), the intervention group did not make statistically significantly greater gains in handwriting legibility than the control group (Table 3). This remains true when the percentage of children in each group with legible handwriting was computed (Table 4). These results were unexpected as there is a growing body of literature documenting the effectiveness of using a published handwriting curriculum on handwriting legibility (Engel et al., 2018; Pfeiffer, Rai, et al., 2015; Zylstra & Pfeiffer, 2016). Additionally, children in kindergarten are expected to make improvements regardless.

This study suggests that improvement in handwriting legibility may not be linear throughout the school year. The children in both groups made statistically significantly more gains in handwriting legibility during the first half compared to the second half of the school year. There could be numerous causes for the observed pattern of improvement, which the current study was not designed to elucidate. For example, it is possible that, developmentally, children's handwriting improves most during the first half of the school year for kindergarten. It is also plausible that the focus on handwriting instruction decreases in the second half of the school year. These hypotheses could be tested in future studies.

Visual-Motor Integration and Handwriting Legibility

Some literature suggests a relationship between children's visual-motor and visual perceptual skills and handwriting legibility (Feder & Majnemer, 2007). Specifically, it has been found that being able to copy the first nine forms on the VMI is associated with greater

handwriting legibility (Daly et al., 2003; Weil & Amundson, 1994). However, in the current study a weak association was found between visual-motor skills and handwriting legibility, whether full scores or the first nine forms score were used. Children in both groups did not make statistically significant improvements in VMI and motor coordination skills, even though their handwriting legibility improved significantly. These results support the findings of Pfeiffer, Moskowitz and colleagues (2015) who previously found that the VMI might not detect changes or be an effective outcome measure for handwriting legibility. However, contrary to their findings, no correlation was found between visual-motor integration scores and handwriting legibility in this study. In addition, the control group visual-motor integration skills deteriorated significantly while their handwriting legibility improved significantly. These findings bring to question the conclusion made by Daly and colleagues in 2003; given their small sample size (n = 54), further investigation is warranted.

On the other hand, both groups improved significantly in terms of visual perceptual skills from the beginning to the end of the school year. This suggests that visual perception improves during kindergarten, whether due to natural growth or skills taught in academic areas, such as handwriting or reading. No statistical difference was found in improvements between groups for visual-motor integration, visual perceptual skills, or motor coordination.

Kindergarten Teachers Perceptions about Handwriting Instruction

Interestingly, although the study found that both the SMHP curriculum and the standard classroom handwriting instruction resulted in statistically significant improvements, the teachers involved in the study all wanted to use the SMHP curriculum for the next school year. This could be related to the barriers to handwriting instruction voiced by all three kindergarten teachers, namely the lack of handwriting instructional time and the lack of a published handwriting curriculum used by the school district. These barriers to handwriting instruction are congruent with those reported in the literature (Asher & Estes, 2016; Nye & Sood, 2018; Pfeiffer, Rai, et al., 2015). Both intervention classroom teachers noted a decreased burden of lesson planning when using the SMHP curriculum. The lesson planning burden on teachers warrants consideration given current literature noting the increase in instructional time dedicated to core content areas with less time for handwriting instruction (Asher & Estes, 2016; Pfeiffer, Rai, et al., 2015). Lastly, the intervention classroom teachers commented that using the SMHP in both classrooms increased their professional collaboration for handwriting instruction between their classrooms and improved their ability to support struggling students. The teachers' perceptions and feedback lend support for using a published handwriting curriculum, such as SMHP, within kindergarten classrooms.

Limitations

The study utilized a convenience sample of kindergarten classrooms from one elementary school, which created non-equivalency between the groups (i.e., two intervention classrooms to one control classroom). Students were allocated to one of the three classrooms by the school district. Furthermore, the sample size was relatively small with non-equivalent groups

at baseline. Students in the control classroom scored higher at baseline on all subtests of the ETCH-M and Beery VMI compared to the intervention classrooms' scores at baseline. Additionally, the ETCH-M has not been standardized for administration with kindergarten students and administration was modified from the manual instructions. The control classroom experienced a lower overall percentage of students who qualified for federal free or reduced lunch status than students in the intervention classrooms (Table 2), which was used as an indicator for student socioeconomic status. Lastly, the researcher scored all student assessments and was not blinded to group allocation. This limitation was mitigated by inter-rater reliability with the second rater blinded to group allocation.

Conclusion

This study of the effectiveness of utilizing a published handwriting curriculum in kindergarten classrooms in one elementary school lends support for the inclusion of handwriting instruction during the school day for kindergarten students, as both groups made statistically significant improvements in handwriting legibility. However, this study found that there was not a significant difference between teaching approaches (i.e., SMHP vs. standard classroom handwriting instruction) on handwriting legibility or visual-motor integration skills. Nevertheless, the use of the SMHP may be beneficial in decreasing teachers' burden of locating materials and creating lesson plans for handwriting instruction. This study expands the existing handwriting literature while also raising questions and identifying gaps in the literature. Additional research is needed on the developmental progression of handwriting skill acquisition and on the lesson planning burden of teachers in relation to handwriting instruction.

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Appendix A

Semi-Structured Group Interview Questions

1. Describe the approach you normally use when teaching handwriting to kindergarten students. [Probe: Concretely, what does this look like in the classroom? Tell me a little more about your approach. Tell me about the amount of time children practice handwriting.]

2a. Is this the approach that you used to teach handwriting this past school year?

2b. If not, tell me what was different about the approach that you used to teach handwriting this past school year.

3. What is your impression of the strengths and weaknesses of the approach to teaching handwriting that you used this past school year?

4. In your opinion, what was the degree of efficacy of the approach that you use to teach kindergarteners to write legibly?

5. If you used a different approach this past academic year, tell me whether you plan to continue with this approach in the upcoming school year.

6. What would you like to change or do differently to teach handwriting in the upcoming school year?

7. Kindergarteners learn many things. What is your view about the importance of learning to write legibly in kindergarten as compared to the other skills and topics that students are learning?