
Multisensory Approach to Handwriting Remediation: Perceptions of School-Based Occupational Therapists

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KEY WORDS

- fine motor skills
- pediatrics

OBJECTIVE. The purpose of this study was to describe the current practices of school-based occupational therapists regarding their use of multisensory modalities and activities in handwriting remediation.

METHOD. A survey was sent to 313 school-based occupational therapist members of the American Occupational Therapy Association who identified themselves as working in a school system as their primary employment setting. Of these, 198 surveys were returned and analyzed descriptively, resulting in a response rate of 63.3%.

RESULTS. More than 130 different multisensory modalities and activities were documented. Twenty-five of these had previously been reported in the literature, the other 114 were documented, by respondents, within the “other” category. Most respondents reported using 5 or more modalities and activities per student, the most frequent being chalk and chalkboard. No consensus among respondents is apparent about the primary sensory systems stimulated by the modalities and activities. No difference in modality and activity use was found on the basis of demographic variables.

CONCLUSION. Overall findings indicate that the breadth of modalities and activities being used is far greater than that currently found in the literature. The results suggest a need for completing studies designed to examine the use and effectiveness of multisensory modalities and activities in handwriting remediation.

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One of the most important and complex childhood occupations is learning to transmit thoughts and information through written language (Amundson, 1992). Even with recent technological advances that have reduced the need for handwritten communication, handwriting continues to be important throughout a student’s elementary school education (Amundson, 1992; Lindsay & McLennan, 1983). Without legible handwriting, children are denied a mode of communication that is still heavily relied on within our society. At school, children are required to write for a variety of academic purposes, including in-class assignments and tests. At home, children may be required to take phone messages, complete homework assignments, or write letters to family members. Given these requirements, it is no wonder that children spend a considerable amount of time in the first few years of school practicing fine motor paper–pencil skills, such as drawing and writing (Laszlo & Bairstow, 1984).

In a study of the relationship between visuomotor and handwriting skills, Weil and Amundson (1994) concluded that most children who are typically developing will be ready for standard handwriting instruction in the latter part of their kindergarten year. Although students who are typically developing are fairly competent at printed writing tasks by 6 or 7 years of age, students with learning disabilities, developmental delays, or neurological impairments may struggle with a standard handwriting curriculum and the task of writing legibly (Bergman & McLaughlin,

1988). Services that go beyond the scope of a standard handwriting curriculum are needed if these children are to become proficient at the task of handwriting.

Children are frequently referred to school-based occupational therapists for handwriting difficulties in the classroom (Clark-Wentz, 1997; Oliver, 1990). Amundson and Weil (1996) stated that the therapist is responsible for identifying underlying motor, sensory, cognitive, or psychosocial deficits that may interfere with the development of legible handwriting and for selecting intervention strategies to overcome those deficits. Although classroom teachers are primarily responsible for the instruction of handwriting, school-based occupational therapists often support teachers by identifying and treating deficits interfering with the development of this skill (Dennis & Swinth, 2001; Reisman, 1991; Tseng & Cermak, 1993). Through classroom observation and examination of work samples, a therapist is able to identify related performance components and administer assessments designed to determine whether deficits in the identified components exist and to what extent (Amundson & Weil, 1996).

Cornhill and Case-Smith (1996) found that students with poor handwriting, as identified by teacher report, scored significantly lower on three assessments of sensorimotor performance components (eye-hand coordination, visuomotor integration, in-hand manipulation) than students with good handwriting. They also found that scores on assessments of these performance components could be used to predict scores in handwriting performance. Weil and Amundson (1994) also found a significant relationship between visuomotor skills and handwriting performance. These findings are consistent with those of Tseng and Cermak (1993). They also suggest that the assessment of suspected performance component deficits is an important part of a comprehensive handwriting assessment.

When deficits in sensorimotor performance components are identified, a multisensory approach often is taken to remediate handwriting problems (Amundson, 1992; Reis, 1990; Rutherford, 1991; Vickery & Cochran, 1987). However, research on the effectiveness of a multisensory approach has been sparse, and findings have been inconsistent (Harris & Livesey, 1992; Lockhart & Law, 1994; Oliver, 1990). Humphries, Wright, Snider, and McDougall (1992) compared sensory integration therapy and perceptual-motor training in treating children with learning disabilities. They found motor gains in children from both experimental conditions but no group differences or improvements in handwriting performance. As can be seen, previous studies appear to provide support for the use of a multisensory approach for children with learning disabilities, but findings are preliminary.

From the literature, writing tools and surfaces appear to be an important part of a multisensory approach to handwriting. Several studies have examined the effects of different traditional writing materials, such as writing paper and writing tools, on handwriting performance. Lindsay and McLennan (1983) and Weil and Amundson (1994) reported that for beginning writers, lined paper may add an element of confusion and compromise legibility. Krzesni (1971) found the opposite to be true for older children—legibility improved with lined paper in 9-year-old children. Halpin and Halpin (1976) compared handwriting quality in kindergarten children with 1-in.-spaced paper and 1.5-in.-spaced paper and found no significant differences. In a study of writing tools, Lamme and Ayris (1983) found that writing tools did not affect legibility. Krzesni, on the other hand, found a significant increase in writing performance with a felt pen.

Although traditional writing instruction involves sitting at a desk with paper and a no. 2 pencil, a multisensory approach to handwriting uses a plethora of modalities and activities (Amundson, 1992). The Appendix lists the modalities and activities that have been indicated in the literature. Although studies have provided preliminary support for the effectiveness of a multisensory approach in children with handwriting readiness and handwriting problems (Harris & Livesey, 1992; Lockhart & Law, 1994; Oliver, 1990), no attempt has been made to document systematically the multisensory modalities and activities that school-based occupational therapists use. Studies have compared a multisensory approach with nonmultisensory approaches without documenting the effectiveness of the specific multisensory modalities and activities. Further, these studies have not defined consistently the meaning of a multisensory approach.

Therefore, the purpose of the present study was to determine by national survey what multisensory modalities and activities U.S. school-based occupational therapists currently use in the remediation of handwriting problems in school-age children and to compare these practices to current literature on the subject. Specifically, the study attempted to answer the following questions:

1. What are the most frequently used multisensory modalities and activities in the remediation of handwriting problems, and how many different modalities and activities do therapists use per student?
2. Is there consensus among school-based therapists about which sensory systems the modalities and activities address?
3. Is there a difference in the multisensory modalities and activities used on the basis of demographic variables?

For the purpose of this study, multisensory approach to

handwriting remediation involves using a variety of sensory experiences, media, and instructional materials to control the sensory input and tap into the child's sensory systems, including the proprioceptive, vestibular, tactile, visual, auditory, olfactory, and gustatory senses (Amundson & Weil, 1996).

Method

Sample

A sample of 313 occupational therapists out of approximately 5,000 was randomly selected by the American Occupational Therapy Association's (AOTA's) direct mail service. Therapists eligible for selection were those members who identified themselves as working in a school system as their primary employment setting, recognizing, however, that their employer may be a hospital or private clinic, they may be an independent contractor with the school system, or both. According to the 1996 AOTA Member Data Survey, 17.9% of all registered occupational therapists indicated working in a school system as their primary employment setting (AOTA Research Department, personal communication, November 4, 1997). Because approximately 35,500 registered occupational therapists are members of AOTA, our sample represents approximately 1% of all members and approximately 5% of all school-based occupational therapist members.

Instrument

Each therapist in the sample received a three-part survey by mail. The first part focused on demographic information, such as years of experience as an occupational therapist, last year completed working as a school therapist, age group of children with which the therapist primarily works, employment status within the school, caseload, service delivery model used by the school setting, current position of employment, certification or training status, and geographical setting. The second part consisted of a list of 25 multisensory modalities and activities and a 5-point Likert scale (1 = never, 5 = very often) for respondents to indicate the frequency of use of each modality and activity. Respondents also were asked to indicate the primary sensory systems they believed each modality and activity addressed. Three closed-ended questions asked them to indicate (a) their top-five modalities and activities used most often, (b) the average number of modalities and activities used per student, and (c) the frames of reference used in handwriting remediation. An open-ended question provided respondents the opportunity to explore what they might say to a school administrator who inquired about the rationale behind a multisensory approach. The third part of the survey was a comment

section, inviting respondents to clarify, add to, or comment on any of the survey's contents.

The survey was designed for one-time use; therefore, reliability and validity are unknown. Content of the survey was based on an extensive literature review and feedback from the researcher's faculty advisor and five pilot study participants with extensive experience in schools, research, or handwriting remediation. Recommendations for changes primarily focused on organization and wording rather than on survey content. After these changes were made, the survey was reviewed once more by two therapists who have worked in public schools.

Data Collection

Questionnaires were sent to the sample, with a follow-up mailing at 3 weeks to increase the response rate (Salant & Dillman, 1994). A stamped return envelope was included with each questionnaire. Mailing labels were coded for confidentiality.

Data Analysis

Data from returned surveys were analyzed with the Statistical Package for the Social Sciences (SPSS, 1995). Frequency distributions were used to describe the sample demographics, the use of each of the 25 modalities and activities and the primary sensory systems the respondents believe each modality and activity addresses, the number of modalities and activities used per student, and the characteristics of the rationale described in response to the open-ended question. Measures of central tendency were used to describe mean years of experience and mean caseload. Chi-square analysis was used to compare the responses received from the first mailing with those received from the second mailing to detect possible response bias. Chi-square analysis also was used to assess the relationship between modalities and activities used and demographic information.

Results

Of the 313 surveys in the first mailing and the 208 in the second mailing to school-based occupational therapists, 207 were returned. Of these, 198 were analyzed, resulting in a 63.3% response rate. Eight surveys were returned blank, and 1 survey from the second mailing had a matching identification number to 1 from the first mailing. Three returned surveys were missing only demographic information, but they were included in this study to increase the number of respondents included in the descriptive statistics on multisensory modality and activity use.

Question 1 asked whether respondents use a multisensory approach in treating children with handwriting prob-

lems. The majority (92.1%) indicated yes. Those responding no were asked to stop and return the survey without completing the rest, and these were not used in the analysis.

The frequency distributions for the demographic variables are presented in Table 1. The majority of respondents reported working in public schools (83.9%) of which 60.0% were full-time employees. Suburban schools was the most frequently reported setting (48.6%). Respondents primarily served the kindergarten to junior high school age group (6–15 years) (74.7%) under the service delivery model of individual or small group pull-out (49.2%). Respondents reported having the most years of experience as occupational therapists in the public schools ($M = 9.14$ years, $SD = 5.87$), with a mean caseload of 38.13 students ($SD = 21.83$). Respondents working in schools often work with students across a variety of ages and may be employed by a facility other than the school. These demographic variables were not used to exclude respondents as long as they answered yes to Question 1.

Frequency distributions of respondents reporting using each of the 25 modalities and activities as often or very often and the primary sensory system indicated for each modality and activity are shown in Table 2. A majority of respondents reported using chalk and chalkboard (87.3%), magic markers or felt pens (76.0%), verbal description while student writes (71.2%), finger writing in viscous substances (64.8%), and copying and tracing on regular lined paper (63.2%) and colored or embossed lined paper

(61.0%) often or very often. Only 7.6% used bags of hair gel for finger tracing often or very often. The primary sensory system reported ranges from 64.1% agreement for design copying on paper strips and masking tape on the floor (visual) to 100.0% agreement for wrist weights (proprioceptive) (see Table 2).

The most frequently reported number of multisensory modalities and activities used per student was five or more (36.9%), whereas 8.9% reported using two and none using only one. Respondents using three multisensory modalities and activities per student were 32.4%, and 21.8% used four per student.

Questions 10 and 11 of the survey allowed respondents to add additional multisensory modalities and activities to the list. Respondents added 114, 13 of which were mentioned five or more times. These modalities and activities are forming letters with pipe cleaners or Wikki Stix^{®1} ($n = 30$); forming letters with play dough, clay, or putty ($n = 16$); using vibrating pens ($n = 13$); writing with water on chalkboard with sponges or paint brushes ($n = 11$); Handwriting Without Tears^{TM2} ($n = 11$); finger writing with vision occluded ($n = 9$); Callirobics^{TM3} or writing to music ($n = 8$); combining activities with therapy ball or scooter ($n = 8$); drawing on student's back or hand ($n = 7$); using body to form letters ($n = 5$); weight bearing on forearms in prone ($n = 5$); tracing tactile letters with fingers ($n = 5$); and using computer activities ($n = 5$). Of the 114 different modalities and activities included in the returned surveys, 72 are mentioned only once. None of the 114 different modalities and activities were included in the data analyses.

Chi-square tests of independence revealed no significant differences in multisensory modality and activity use based on the demographic variables of service delivery model, primary age group of students served, employment status, and geographical setting. For years of practice in public schools, a significant difference was found for 1 of the 25 modalities and activities: design copying on paper strips and masking tape on the floor, $X^2(6, 176) = 23.9, p < .001$, that is, more respondents with 5 to 9 years of experience reported a frequent use of this modality than expected. For caseload, a significant difference also was found for 1 of the 25 modalities and activities: bags of hair gel for finger tracing, $X^2(4, 177) = 19.5, p < .001$, that is, more respondents with caseloads of greater than 50 reported the frequent use of this modality than expected.

Table 1. Frequency Distributions for Demographic Variables^a

Variable	<i>n</i>	%
Employment status directly in school setting ($n = 180$)		
Full time	108	60.0
Part time	59	32.8
Not at all	13	7.2
Current position of employment ($n = 180$) ^b		
Public school	151	83.9
Other ^c	68	37.8
Geographical setting ($n = 179$)		
Suburban	87	48.6
Rural	51	28.5
Urban	41	22.9
Primary age group ($n = 162$)		
Early intervention (0–3 years)	5	3.1
Preschool (3–5 years)	36	22.2
K to junior high (6–15 years)	121	74.7
High school (16–21 years)	0	0.0
Service delivery model ($n = 177$)		
Individual or paired pull-out	87	49.2
Student in classroom	47	26.6
Small group pull-out	12	6.8
Classroom consultation	12	6.8
Small group in classroom	10	5.6
Set up and monitor intervention	7	4.0
Entire classroom	2	1.1

^aParticipants who responded yes to working in a school system.

^bRespondents were allowed to indicate more than one current position of employment. ^cOther positions of employment respondents indicated included private contracted services, private school, hospital, and private practice.

¹Omnivor, Inc., 2432 West Peoria #1188, Phoenix, Arizona 85029; www.wikkistix.com.

²Jan Olsen, OTR, 8802 Quiet Stream Court, Potomac, Maryland 20854; www.hwttears.com.

³CallirobicsTM, PO Box 6634, Charlottesville, Virginia 22906; www.callirobics.com.

Table 2. Frequency Distributions^a of Therapists Reporting Modality and Activity Use as Often or Very Often and Primary Sensory Systems

Modality and Activity	<i>n</i>	%	Primary Sensory System (PSS)		
			PSS	<i>n</i>	%
Chalk and chalkboard	157	87.3	P	149	85.6
Magic markers or felt pens	139	76.0	I	138	80.7
Verbal description of letter shapes while student writes	129	71.2	A	156	95.1
Viscous substances, such as shaving cream, for finger writing	118	64.8	T	159	95.2
Copying and tracing letters on regular lined paper	115	63.2	I	140	84.8
Colored or embossed lined paper	111	61.0	I	131	79.4
Forming letters in a tray of rice or sand with a finger	87	48.1	T	158	95.8
Letter forming with a finger or dowel in clay	85	46.9	T	136	82.9
Tracing or copying letters over a rough surface	82	45.1	T	148	89.2
“Sky writing” letters in the air	78	43.3	P	155	91.7
Block design	70	39.1	I	141	87.6
Bead stringing	65	35.7	T	122	73.9
“Rainbow writing” using different colors to copy the same letter	60	33.0	I	137	87.8
Colored writing lines that represent the sky, grass, and dirt	56	30.7	I	131	89.7
Grease pencils on a plastic template over letters	50	27.6	I	107	70.4
Carpet squares and chalk	47	26.2	T	128	85.9
Dried glue for writing lines	47	25.8	T	145	92.9
Parquetry	43	23.7	I	126	85.1
Wrist weights	43	23.7	P	153	100.0
Paper folding	40	21.9	T	98	64.9
Design copying on paper strips and masking tape on the floor	25	14.0	I	84	64.1
Shape tracing behind a masking box with vision occluded	21	11.5	P	99	75.6
Tracing letters with a magic marker over cellophane	20	10.9	I	85	65.4
Black construction paper covered with salt	18	10.0	T	125	88.0
Bags of hair gel for finger tracing	14	7.6	T	131	92.9

Note. P = proprioceptive; I = visual; A = auditory; T = tactile.

^aRespondents who left these questions blank were not included.

When provided with a hypothetical scenario involving explaining the rationale for the use of multisensory modalities and activities to a school administrator, at least 50% of the respondents provided explanations. The explanations most often addressed a particular modality or activity that the respondent reported using, as in the following example:

I often have the child form letters on the blackboard to promote wrist extension and use small pieces of chalk to promote good pencil grasp. We draw letters on the board, trace them, say how to draw the lines, [and] draw with eyes closed, so many sensory systems are alerted and the letter pattern becomes part of the muscle memory.

Common themes identified in the explanations were making learning fun, tapping into as many senses as possible, and stressing the importance of exploring and finding the ways that students learn best. All of these themes are reflected in the following statement by one respondent:

The more sensory pathways stimulated during a learning task for both children and adults, the more success we have and the greater our memory for the task will be. Also, the more interesting I make the activity, the more likely the child/children are to participate, enjoy, and remember.

Discussion

A multisensory approach to treating children with handwriting problems is an important and frequent area of practice for school-based occupational therapists as indicated by

the significantly large percentage of respondents (92.1%) reporting use of this approach. Descriptive statistics revealed that the highest percentage of respondents work with preschool-age through junior high school-age students on handwriting. The fact that the greatest percentage work with these age groups could be explained partly by well-known theories of neural plasticity. These theories suggest that younger children may benefit greatly from therapy because of their rapidly developing and changing nervous systems (Parham & Mailloux, 1996). For younger and older groups, other skills may be more of a focus than handwriting skills. Because there was no way for therapists not working on handwriting to indicate this on the survey, the very few respondents who indicated working in early intervention or high school settings may have found the survey to be irrelevant to their practice and, thus, may have contributed to the rate of nonrespondents.

In addressing the study's first question of which multisensory modalities and activities are used most often in the remediation of handwriting problems, results indicate that of the 25 presented, 6 are used often or very often by at least 60% of the respondents (see Table 2). It was expected that therapists would have reported using more of the 25 often or very often because they were cited in the literature (Amundson, 1998; Harris & Livesey, 1992; Lockhart & Law, 1994; Oliver, 1990; Weiser, 1986) and, therefore, assumed to be used frequently. The fact that respondents

reported 114 additional modalities and activities and that 36.9% indicated using 5 or more per student indicate a wide range of multisensory modalities and activities used in the remediation of handwriting problems and that therapists are creative when implementing a multisensory approach.

Multisensory modalities and activities appear to fall into four general categories. As stated in the literature review, writing tools and writing surfaces are an important part of a multisensory approach to handwriting. The results of this survey support this statement. Three of the modalities and activities used most often involve adaptations to standard writing tools and surfaces (e.g., magic markers, vertical or slanted writing surfaces). Commercially available writing programs (e.g., Callirobics, Handwriting Without Tears) also emerged in the results. Many respondents mentioned specific performance components, including intrinsic muscle development and eye tracking. Finally, many modalities and activities involved the use of common children's toys (e.g., play dough, Etch-a-Sketch^{®4}).

Results for the second research question of whether consensus exists among school-based therapists about which sensory systems they believe the modalities and activities address are inconclusive. Some respondents indicated only one sensory system for each modality and activity, whereas others indicated anywhere from one to six. This pattern of responses does not demonstrate whether those who indicated only one sensory system made their selection on the basis of their understanding of the question or because they believe it to be the only sensory system affected. Because many of the modalities and activities address more than one sensory system, respondents may have found it difficult to determine which sensory systems are "primarily" stimulated. Additionally, although different respondents may be using the same modalities and activities, they may be doing so for the purpose of stimulating different sensory systems.

In addressing the study's third research question, no differences in modality and activity use appeared to be based on demographic variables. Exceptions are noted for only 1 of the 25 both for years of practice in public schools and for caseload. For the most part, these general results indicate that school-based therapists across the United States are using similar multisensory modalities and activities no matter the service delivery model, size of caseload, primary age group of students, years of school-based practice, geographical setting, or employment status. It appears that many students receiving occupational therapy services

for handwriting problems are being exposed to a wide range of multisensory modalities and activities, but demographic variables are not related to the modalities and activities used. This survey did not gather data related to the clinical reasoning behind the respondents' choices, which may be worth exploring in future studies.

Responses to the open-ended question that asked respondents to explore what they might say to a school administrator who inquired about the rationale behind the use of a multisensory approach indicate that therapists believe in the importance of a multisensory approach to handwriting. This belief, as well as the belief in the importance of selecting modalities and activities based on the student's individual needs, is reflected in the following statement from a respondent: "It is very important to use a variety of modalities/activities in the remediation of handwriting. The stimulation, fun, interest and motivational factors play a part in the activities chosen for each child." It may be that the high number and variety of modalities and activities indicated by respondents make it possible to meet a variety of student needs.

Implications for Occupational Therapy

The results of this study indicate that approximately 90% of school-based occupational therapists responding to this survey use a multisensory approach when treating students identified as having handwriting difficulties. Through existing research and the results of this study, more than 130 different multisensory modalities and activities have been identified as being used in the remediation of handwriting problems. The use of these modalities and activities does not appear to be related to demographic variables. The results of this study suggest that therapists are imaginative in devising and have a wide range from which to choose of multisensory modalities and activities for use in handwriting remediation.

Limitations

Limitations of this study include unclear wording of certain survey questions, all respondents being members of AOTA, and missing data. As stated earlier, some of the survey respondents indicated one sensory system when asked to identify the primary sensory systems for each modality and activity, whereas others indicated up to six, which may be due to potential unclear wording of the survey. It is unclear whether some respondents thought that they should indicate only one "primary" sensory system or whether they believed that only one sensory system is stimulated by the modality and activity. Several respondents did not complete the demographic sections of the survey, whereas others did not respond to some of the items regarding multisensory

⁴The Ohio Art Company, One Toy Street, PO Box 111, Bryan, Ohio 43506-0111; www.world-of-toys.com.

modalities and activities, resulting in some item-wise exclusions during data analysis.

Directions for Future Research

This research was a pilot study. Suggestions for further research are to examine the effectiveness of those modalities and activities used most often in the remediation of handwriting problems, modify the survey item regarding primary sensory systems to specify the number of responses sought, and carry out a qualitative study that addresses clinical reasoning of school-based therapists and why different modalities and activities are chosen.

Conclusion

A survey study was conducted to describe the current use of a multisensory approach to handwriting remediation by school-based occupational therapists. Results revealed a large number of multisensory modalities and activities being used by occupational therapists. However, only a few of them were used often or very often by at least half of the respondents. The number of different modalities and activities identified in this study as being used in a multisensory approach to handwriting remediation is greater than previously expected and indicates room for creativity when designing individual treatment. Consensus among respondents about the primary sensory systems targeted by the modalities and activities is inconclusive. On the basis of the broad and varied results obtained in this study, further quantitative and qualitative research is needed in this area to examine further therapists' clinical reasoning related to a multisensory treatment approach to handwriting problems. A clearer understanding of the reasoning leading to the different modalities and activities identified may help with the efficiency and effectiveness of school-based occupational therapy focused on handwriting. This understanding, in turn, may improve students' occupational performance in handwriting.

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ter's degree in occupational therapy at the University of Puget Sound in Tacoma, Washington.

Appendix

Multisensory Modalities and Activities Used in Handwriting Remediation Found in the Literature

- "Rainbow writing" using different colors to copy the same letter
- "Sky writing" letters in the air
- Bags of hair gel for finger tracing
- Bead stringing
- Black construction paper covered with salt
- Block design
- Carpet squares and chalk
- Chalk and chalkboard
- Colored or embossed lined paper
- Colored writing lines that represent the sky, grass, and dirt
- Copying and tracing letters on regular lined paper
- Design copying on paper strips and masking tape on the floor
- Dried glue for writing lines
- Forming letters in a tray of rice or sand with a finger
- Letter forming with a finger or dowel in clay
- Grease pencils on a plastic template over letters
- Magic markers or felt pens
- Paper folding
- Parquetry
- Shape tracing behind a masking box with vision occluded
- Tracing letters with a magic marker over cellophane
- Tracing or copying letters over a rough surface
- Verbal descriptions of letter shapes while student writes
- Viscous substances, such as shaving cream, for finger writing
- Wrist weights

(Compiled from Amundson, 1998; Harris & Livesey, 1992; Lockhart & Law, 1994; Oliver, 1990; Weiser, 1986)

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