SPELLING INTERVENTIONS FOR STUDENTS WITH DISABILITIES: A REVIEW

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This article reviews published research on spelling interventions designed for students with learning disabilities (LD) who are poor spellers. Thirty-eight spelling studies, including single-subject and group designs, were located. Study interventions consisted of four types: instructional techniques, computer-assisted instruction, study strategies, and multisensory/modality training. These studies are discussed here with regard to subjects, methods, and findings. Conclusions and implications for spelling instruction and for future research are presented.

Students with learning disabilities (LD) have lower achievement levels than their low-achieving nondisabled peers across all subject areas, but spelling ability is the most powerful discriminator between students with LD and other low achievers (Deshler, Schumaker, Alley, Warner, & Clark, 1982). Although spelling deficits are frequently identified during elementary school years, these deficits increase as students reach secondary education levels (Poplin, Gray, Larsen, Banikowski, & Mehring, 1980). One study documented a third-grade mean spelling score among seventh-grade adolescents with LD (Deshler, Schumaker, Alley, Warner, & Clark, 1982).

Spelling is closely related to other subjects, particularly to reading (Beers, 1980). However, controversy exists between researchers who contend that spelling is a natural extension of reading and others (e.g., Chomsky, 1979) who argue that writing, a more concrete task, developmentally occurs first (see Vacca, Vacca, & Gove, 1987, for a discussion). Nevertheless, agreement exists that spelling is a more difficult task than reading (Frith, 1980; Mastropieri & Scruggs, 1987; Nelson, 1980); it requires production of an exact sequence of letters, offers no contextual clues, and requires greater numbers of grapheme-to-phoneme decisions.

There are several possible reasons for the persistence of severe spelling deficits for students with LD. First, teacher preparation for spelling instruction may be overlooked, due to an overriding emphasis on the instruction of reading and mathematics. Second, minimal instructional time may be allocated to spelling due to beliefs that spelling is of secondary importance in today's extensive curriculum. Third, believing that students acquired these techniques in the primary grades, teachers may neglect instruction in effective spelling strategies.

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However, there are reasons to be optimistic about helping students with LD to learn to spell. First, the spelling skill of students with LD is similar developmentally to that of nondisabled students (Gerber, 1986). Second, cognitive strategies, such as those employed for spelling, are generalizable to other academic areas, particularly with training for transfer and teacher prompts (Deshler et al., 1983). Third, in 35 of the 38 spelling interventions presented in this review, explicit spelling instruction resulted in improved spelling performance.

Given the severity of spelling deficits for many students with LD, and the relationship between spelling and school success, it is important to synthesize the results of research interventions with this population. To date, a comprehensive review of this literature has not been published. Prior spelling reviews have focused on empirically supported instructional procedures (Graham & Miller, 1979); implications for students with and without LD (Graham & Stoddard, 1987); cognitive–behavioral training (CBT) across academic areas, including spelling (Gerber & Hall, 1989); and the theoretical and developmental aspects of spelling (A. S. Brown, 1990). The most recent review (Gordon, Vaughn, & Schumm, 1993) presented only 17 interventions for students with mild disabilities (including LD and mild mental handicaps). This article, however, provides a critique of 38 studies conducted specifically with students with LD. A common metric is provided for comparing study outcomes. In addition, methodological issues and implications for the classroom and for future research are also provided. This is important information for teachers’ decision making regarding effective instructional techniques (Vallecorsa, Zigmond, & Henderson, 1985) and for conducting subsequent spelling research.

METHOD

Search Procedure

A computer-assisted search was conducted of the following databases: ERIC, Exceptional Child Education Resources, and Psychological Abstracts. Descriptors included “interventions, instruction, or strategies” and “learning disabilities” or “mild handicaps.” Additional means of locating studies included tracking citations from related articles and obtaining reports of recent spelling research directly from the authors. Finally, relevant studies were located through noncomputerized searches of the following journals (from January 1980 to January 1994): Exceptional Children, Journal of Applied Behavior Analysis, Journal of Learning Disabilities, The Journal of Special Education, and Learning Disability Quarterly. Searches of Learning Disabilities Research and Learning Disabilities Focus (currently Learning Disabilities Research and Practice) were also conducted from the first issues in 1985 to January 1994.

Selection Criteria

Four criteria were employed in the selection of studies for this review. First, only studies with subjects identified as learning disabled were included. Although controversy exists about the exact nature of LD, the following identification
guidelines provided some consistency: (a) achievement scores at least 1.5 years behind grade level, (b) an IQ of 85 or higher, and (c) recommendation for special services by a case conference committee. In each study, unless otherwise noted, subjects were identified as learning disabled. Studies whose subjects were described only as poor spellers (Gettinger, 1985; Wong, 1986), students with special needs (e.g., Lew & Bryant, 1984; Olrich, 1983), or students with behavioral disorders and attention difficulties (Fitzgerald, Fick, & Milich, 1986) were excluded from this review.

Second, articles that described spelling strategies without providing evidence of systematic employment of these strategies were excluded (e.g., Yudkovitz, 1979; Zylstra, 1989). The third criterion for inclusion in this review was that spelling, rather than reading, outcomes were measured (e.g., DiVeta & Speece, 1990). If both spelling and reading outcomes were measured (e.g., Englert, Hiebert, & Stewart, 1985), only the spelling components are described. Finally, only published studies were included in the review, which may represent a possible bias. As Lipsey and Wilson (1993) recently noted, published research may report larger effects and stronger research designs than unpublished papers.

Effect sizes (ES) or percentage of nonoverlapping data (PND—percentage of intervention data points that exceed the highest point within the baseline condition [Scruggs, Mastropieri, & Casto, 1987]) were calculated when sufficient data was provided. For example, single-subject outcomes were quantified by calculating the PND. Group effects were calculated with the following formula: \( ES = \frac{M - \mu}{\sigma} \) of the experimental group – \( M \) of the control group/standard deviation of the control group, as described by Glass, McGaw, and Smith (1981).

**STUDY CHARACTERISTICS**

This review is an exploration of 38 empirical investigations, including 19 single-subject designs and 18 group designs. In aggregate, these studies included 1,174 students with LD. Thirty studies reported subjects’ ages (\( M = 10.7 \) years) and eight studies reported grade levels with ranges of Grades 1 through 12. The length of interventions varied from one session to 1 year (\( M = 24 \) sessions) and session duration ranged from 4 minutes to 3.5 hours (\( M = 21 \) minutes). In addition, one investigation was a 4-year longitudinal study and one study failed to report the intervention length or duration. Finally, 35 of 38 studies reported positive effects on spelling performance, rates of on-task behaviors, and/or attitudes toward spelling practice.

Studies are organized and briefly summarized within each of the following sections: (a) instructional techniques, (b) computer-assisted instruction, (c) student study techniques, and (d) sensory/modality training. Table 1 presents summary information for each type of study.

**FINDINGS FOR INSTRUCTIONAL TECHNIQUES**

Instructional techniques for students with LD include contingent imitation modeling, reinforcement procedures, analogy training, time delays, and task variations (e.g., list length, interspersal of known with unknown words). These are presented below and descriptive information is provided in Table 2.
Contingent Imitation Modeling

Four studies were located that implemented contingent imitation modeling, which directs students' attention to discrepancies between misspellings and correct spellings through imitation of errors prior to the presentation of models. In a two-experiment study, Kauffman, Hallahan, Brame, and Boren (1978) alternated weeks of teacher modeling of correct spellings with teacher modeling combined with imitation of students' misspellings during daily chalkboard practice. Subjects included 2 students with mild handicaps (Experiment 1) and a 12-year-old boy in a residential program for LD (Experiment 2). Modeling combined with error imitation resulted in higher scores than modeling-only on 10 of 12 daily scores (PND = 83%), 8 of 10 immediate posttest scores (PND = 80%), and 2 of 2 (PND = 100%) 1-week delayed scores (Experiment 2).

Three similar investigations by Gerber provided further support for employment of error imitation, particularly during testing sequences (i.e., the test correction method). In the first study, Gerber (1984) employed test correction procedures with an 11-year-old bilingual girl on the first of two target lists that were constructed to contain similar critical patterns. Results indicated 50% improved performance on first trials from List 1 to List 2 (the transfer list), mastery in fewer trials on List 2, and improved performance on List 2.

In the second study, Nulman and Gerber (1984) employed the same procedures with an 8-year-old boy whose baseline spelling scores averaged 25% correct. Results paralleled those of Gerber (1984): (a) improvement on first trials from List 1 (55% correct) to List 2 (66% correct) and (b) 40% improvement, from pretest to posttest, on correct letter sequences, a more sensitive measure of spelling improvement.

In the third study, Gerber (1986) implemented test correction procedures during pretesting in a multiple probe study of 11 students (Grades 1 to 9), ages 7 years to 15 years. Critical patterns from List 1 were repeated in List 2 without comment, to measure spontaneous transfer. Finally, it was emphasized to students that
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<tr>
<td>Bryant et al. (1981)</td>
<td>64 with LD (43 boys, 21 girls); M age = 10.2 yrs.</td>
<td>Oral and written practice, immediate corrective feedback, and distributed and cumulative practice on either 3, 4, or 5 words per day</td>
<td>3 sessions; 3 days; 30-40 min. each</td>
<td>Scores of 3-word group &gt; 4-word (ES = .75) &amp; 5-word groups (ES = 1.15) on number of common words spelled correctly</td>
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<td>Englert et al. (1985)</td>
<td>18 with LD; 4 with EMR; 2nd grade</td>
<td>Analogy rule training and training for transfer vs. traditional instruction (TI)</td>
<td>3 sessions; 10 min. each</td>
<td>Experimental &gt; TI on target (ES = 1.1) + transfer words (ES = 1.35)</td>
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<td>Gerber (1984)</td>
<td>1 11-yr.-old bilingual girl</td>
<td>Imitation of errors, modeling, and corrective feedback (test correction)</td>
<td>16 trials total</td>
<td>Fewer trials to mastery on List 2</td>
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<tr>
<td>Gerber (1986)</td>
<td>11 with LD; M age = 10 yrs.; Grades 1-9</td>
<td>Imitation, modeling, training for generalization (test correction)</td>
<td>11 sessions; 1 per day</td>
<td>Fewer trials to mastery on generalization Lists 2 and 3</td>
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<td>Gettinger et al. (1982)</td>
<td>39 with LD (23 boys; 16 girls); M age = 9 yrs.</td>
<td>Small unit size, distributed practice with feedback systematic review, and training for transfer vs. traditional instruction (TI)</td>
<td>8 sessions; 30 min. each</td>
<td>Experimental &gt; TI on both target (ES = .94) and transfer words (ES = 1.22)</td>
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<td>Kaufman et al. (1978)</td>
<td>1 with LD; 12 yrs.</td>
<td>Model only vs. imitation + model</td>
<td>20 sessions; 30 min. each</td>
<td>Imitation + model &gt; model only on daily scores (PND = 83%), and on immediate (PND = 80%) and delayed (PND = 100%) posttests</td>
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<tr>
<td>Nulman &amp; Gerber (1984)</td>
<td>1 boy with LD; 8.5 yrs.</td>
<td>Contingent imitation modeling procedures (test correction)</td>
<td>9 sessions; 2 per day</td>
<td>Improvement from first trials to subsequent lists for word and correct letter sequences</td>
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<td>Ollendick et al. (1980)</td>
<td>1 boy with LD and aggression; 10 yrs.; 1 girl with LD; 8 yrs.</td>
<td>Compared positive practice (PP), positive practice + reinforcement (PPR), and no-treatment control</td>
<td>25 sessions</td>
<td>PPR (69%) &gt; PP (65%)</td>
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<td>Compared positive practice plus reinforcement (PPR), traditional corrective instruction plus reinforcement (TCR), and traditional corrective instruction only (TCI)</td>
<td>25 sessions</td>
<td>PPR (80%) &gt; TCR (60%), TCI (40%)</td>
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<td>Singh et al (1991)</td>
<td>4 boys with LD; M age = 15 yrs.</td>
<td>Rehearsal with corrective praise vs. rehearsal with corrective praise + interspersal of known words</td>
<td>39 sessions; 3-5 min. each</td>
<td>Rehearsal, rehearsal + interspersal &gt; baseline (PNDs = 70%)</td>
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<tr>
<td>Stevens &amp; Schuster (1987)</td>
<td>1 boy with LD; 11 yrs.</td>
<td>Delayed time trials and corrective feedback</td>
<td>2 lessons; 60 min. each</td>
<td>Probes posttraining = 73%-100% correct across word sets; generalization $M = 93%$ correct</td>
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Note. ES = effect size; PND = percentage of nonoverlapping data; LD = learning disabilities; EMR = educable mental retardation.
that critical patterns from List 2 would facilitate the study of a third list. Results of this investigation were consistent with the earlier studies: (a) Criterion on subsequent lists was achieved in fewer trials, (b) improvement occurred on initial trials on subsequent lists (e.g., List 1, 15% correct; List 3, 74% correct), and (c) highest performance was obtained on List 3. Some generalization occurred without prompting on the second list. However, explicit instruction to transfer resulted in the highest performance.

Reinforcement Procedures

Ollendick, Matson, Esveldt-Dawson, and Shapiro (1980) investigated reinforcement (stars and praise) of correct spellings by alternating positive practice (PP) and positive practice with reinforcement (PPR) in two experiments. Subjects were a 10-year-old White boy and an 8-year-old African-American girl hospitalized for aggression and learning problems (Experiment 1). PPR resulted in improved performance over PP (PND = 69%) and was implemented across word sets in Phase 3 (PND = 81%). In the second experiment, a 13-year-old girl preferred PPR and exhibited improved performance (PND = 80%) over correction plus reinforcement (PND = 60%) and traditional correction procedures (PND = 40%). Results support the use of reinforcement to enhance skill fluency (e.g., Smith & Lovitt, 1976).

Analogy and Training

Engler et al. (1985) compared an analogy strategy condition, which emphasized critical orthographic patterns, to a traditional instruction condition for spelling of target and transfer words. Subjects were 18 students with LD and 4 with mild handicaps, who were referred by teachers for reading and spelling difficulties. Following random assignment, subjects in the analogy condition were instructed to apply the following rule with sample transfer words: “rhyming words often contain spelling similarities.” Analogy training resulted in more improved performance on target words (ES = 1.1) and transfer words (ES = 1.35) than traditional study conditions.

Constant Time Delay

In constant time delay procedures, the spelling of a target word is requested and wait time is systematically increased before a correct model is presented. Stevens and Schuster (1987) obtained encouraging results using this technique with an 11-year-old, middle-socioeconomic status (SES) boy. Scores improved from 0% to 13% correct during Probe 1 (i.e., pre-instruction) to scores of 73% to 100% correct across three word sets (Probes 2 through 4) and generalization probes (M score = 93% correct). Trials to criterion increased across word sets, unlike the studies of error imitation. It may be that the 10-second time-out that was administered following misspellings was aversive to the subject. Incorporating self-correction procedures with time delay might have increased the efficacy of this intervention.
Task Variations

Variations of spelling tasks that have been investigated included list length, distributed practice, and interspersal of known with unknown words. Each is described next.

Varying List Lengths. Bryant, Drabin, and Gettinger (1981) investigated the effects of varying list lengths with 64 10-year-old subjects (43 boys and 21 girls) from mixed-SES backgrounds. Subjects were “nearly” randomly assigned to groups, which varied only in the number of words for which they received daily instruction. The three words per day condition resulted in improved performance on core words (83% correct) compared to scores of 54% for the four word (ES = .75) and 49% for the five word conditions (ES = 1.15). Regardless of numbers of words for which instruction was given, student performance did not differ on the number of posttest words spelled correctly. Numbers of errors increased proportionately with numbers of target words.

Distributed Practice. Gettinger, Bryant, and Fayne (1982) investigated effects of a multicomponent package that combined (a) limited list length, (b) distributed practice with immediate feedback, (c) explicit training for transfer of phonetically regular words, and (d) systematic review. Subjects were 39 students (23 boys and 16 girls; M age = 9 years) of mixed racial and ethnic groups from predominantly low-SES backgrounds. The experimental condition resulted in higher performance at posttest than a traditional instruction condition on regular words (ES = .94) and transfer words (ES = 1.22). However, there was a confounding factor: Subjects in the control condition studied 24 transfer words, in addition to the training words, which resulted in less study time per word than in the experimental condition. Of course, it is not possible to compare the relative effectiveness of the various treatment components in combined intervention packages such as this one.

Interspersal of Known Words. Singh, Farquhar, and Hewett (1991) investigated the effects of alternating conditions of directed rehearsal (DR) versus directed rehearsal with interspersal of known words (DR+I). Subjects were 4 boys (M age = 15 years) whose primary difficulties were in reading and spelling. In the DR condition, the subjects were given instruction in words misspelled at pretest, whereas in the DR+I condition, they were given correctly spelled pretest words interspersed with misspelled pretest words. Results indicated that performance improved from baseline under each condition, with no differences between conditions (PNDs = 70%).

Summary of Instructional Techniques

Overall, the 10 investigations (i.e., 7 single-subject and 3 group designs) of instructional variables provide evidence that students with LD acquire spelling skill in a developmental, problem-solving manner. All 10 studies reported improved performance with support for the following instructional techniques:
• Imitation modeling;
• The test correction method;
• Positive practice with reinforcement;
• Analogy training;
• Constant time delay;
• Limited list length;
• Distributed practice.

One concern that has emerged from these studies is the demand for individual teacher assistance for some instructional techniques. Reduced demands for teacher time may occur through the use of computer-assisted instruction (CAI). Interventions of CAI are presented in the next section and listed in Table 3.

FINDINGS FOR COMPUTER-ASSISTED INSTRUCTION

Nine investigations of CAI have been conducted. Studies included three individual instructional programs, two constant time delay programs, and four computer practice programs.

Individual CAI Programs

In the first of three CAI studies, Hasselbring (1982) implemented the Computer Spelling Remediation Program, which combined auditory and visual components to provide imitation modeling and feedback. The subject, an 11-year-old boy, achieved two scores of 90% and two scores of 100% on weekly 20-word tests, although a comparison treatment was not employed. This program also generated a performance summary for teacher monitoring.

In a second study, Rieth, Polsgrove, and Eckert (1984) implemented a CAI program entitled Spellmaster with subjects from Grades 1 through 12 in LD resource programs. The authors reported that scores improved 50% to 70% over baseline, although supporting information was not provided.

In a third study, Hasselbring (1984) alternated weeks of computer imitation modeling plus feedback (IMF) to teacher-provided IMF. The subject, an 11-year-old boy, achieved nearly identical scores under each condition (i.e., 77% under computer modeling and 74% under teacher modeling).

None of the three studies offered baseline data. However, tentative findings from these studies might be interpreted to mean that the computer is a viable way of providing corrective feedback during students’ independent spelling practice.

Constant Time Delay with CAI

Two studies investigated the effects of constant time delay incorporated into computer programs. In the first study (Kinney, Stevens, & Schuster, 1988) the subject, a 12-year-old boy in a tutorial setting, achieved 100% accuracy on three sets of five state names. Performance improved from none correct on the initial trial to means of 85% to 90% correct (PND = 92%) during training sessions. Minimal teacher assistance was required for the acquisition of these 15 difficult
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<tr>
<td>Hasselbring</td>
<td>1 boy with LD; 11 yrs.</td>
<td>Computerized spelling remediation program included word list input, imitation + modeling with feedback, and performance summary</td>
<td>4 weeks; daily sessions</td>
<td>Scored 90% or above on 4 weekly tests and on a 1-week maintenance test</td>
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<td>(1982)</td>
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<tr>
<td>Hasselbring</td>
<td>1 boy with LD; 12 yrs.</td>
<td>Alternated weeks of imitation + modeling procedures administered either by the teacher or the computer</td>
<td>6 weeks; daily sessions</td>
<td>Similar results for teacher, $M = 75%$, and computer feedback $M = 77%$.</td>
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<td>(1984)</td>
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<td>Kinney et al.</td>
<td>1 boy with LD; 12 yrs.</td>
<td>3-word sets taught with the 6-sec. constant time delay using CAI</td>
<td>30 per probe; 17 min.</td>
<td>1 week posttest = 93% correct</td>
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<td>(1988)</td>
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<td>average</td>
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<td>MacArthur et al.</td>
<td>44 with LD; $M$ age = 11 yrs.; Grades 5-6</td>
<td>CAI with immediate feedback vs. independent practice activities with PPI</td>
<td>16 sessions; 4 days per week; 20 min. each</td>
<td>CAI &gt; PPI weekly posttests ($ES = .45$), 1-week delayed posttest ($ES = .40$), and engaged time during practice</td>
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<td>(1990)</td>
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<td>Margalit &amp; Roth</td>
<td>18 with LD; 18 with MR; Ages 11-16; Grades 7-10</td>
<td>Keyboard training and dictation practice</td>
<td>24 sessions; 45 min. each</td>
<td>Fewer errors for both MR and LD but correct scores NR</td>
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<td>(1989)</td>
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<tr>
<td>McDermott &amp;</td>
<td>205 with LD; M age = 10 yrs.; Grades 1-6</td>
<td>Instruction with either the Math Machine or the Spelling Machine CAI software packages vs. traditional instruction</td>
<td>138 day units taught over 1 yr.</td>
<td>NSD</td>
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<td>Watkins (1983)</td>
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<tr>
<td>Rieth et al.</td>
<td>LD; Grades 1-12</td>
<td>Individualized instruction, modeling, feedback, options + output with Spellmaster CAI</td>
<td>NR</td>
<td>50%-70% improvement over baseline</td>
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<td>(1984)</td>
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<tr>
<td>Stevens et al.</td>
<td>3 with LD; 2 with EMH; 11-12 yrs.</td>
<td>CAI and constant time delay procedures</td>
<td>40 sessions; 20 min. each</td>
<td>4/5 reached 100% criterion; M on generalization probe was 81% 1 day following training</td>
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<td>(1991)</td>
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<tr>
<td>Watkins (1989)</td>
<td>126 with LD (88 boys, 38 girls); M = 3.75</td>
<td>CAI included drill + practice with the Spelling Machine or the Math Machine</td>
<td>1 yr.</td>
<td>Students reported favorable attitudes towards CAI</td>
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Note. NR = not reported; NSD = no significant difference; ES = effect size; PND = percentage of nonoverlapping data; CAI = computer-assisted instruction; PPI = pencil-and-paper instructions; LD = learning disabilities; EMH = educable mental handicaps; MR = mental retardation.
spellings. An additional positive outcome was the achievement of 93% accuracy on a handwritten generalization measure administered 1 week following instruction.

In the second study, Stevens, Blackhurst, and Slaton (1991) employed a multiple probe design across word sets. This investigation was conducted in a resource class with 5 11- to 12-year-old subjects (3 with LD, 2 with mild handicaps). Results were graphed for a representative subject; 100% criterion was achieved in 20 trials for List 1 (six items) and in 5 trials for Lists 2 and 3 (PND = 80%). Mean scores of 81% correct were achieved on a 15-day handwritten generalization probe. One subject was dropped from the study due to noncompliance, which may support the concern voiced by Landeen and Adams (1988) regarding the efficacy of CAI for some students.

**Computer Practice**

Four studies of computer drill and practice were conducted. In the first of two posttest-only studies, Watkins (1989) reported that 126 students (88 boys and 38 girls; M grade = 3.7) expressed more positive attitudes toward computer activities than toward paper-and-pencil practice following 1 year of CAI. The effects of CAI on spelling achievement were not examined in this investigation, whereas achievement scores were examined in a second comparison of CAI to traditional drill and practice (McDermott & Watkins, 1983). Subjects were 205 students with LD in Grades 1 to 6 (M age = 10 years). Following 138 practice sessions, no significant achievement differences were found between conditions.

The third study (MacArthur, Haynes, Malouf, Harris, & Owings, 1990) employed random assignment to compare computer spelling practice to traditional paper-and-pencil practice. Subjects were 44 fifth- and sixth-grade students from self-contained classes for students with LD. Significant improvement was achieved by the subjects in the computer practice condition on weekly spelling tests (ES = .45) and on a 1-week delayed measure (ES = .40). In addition, a higher on-task engagement rate was found for the CAI condition during the practice activities. However, the novelty of computer usage may have affected these results.

In the fourth study, Margalit and Roth (1989) compared pre- and posttest spelling errors and typing times on passage dictation measures following 24 sessions of keyboard practice. Subjects were 18 students with LD and 18 with mild mental handicaps in Israeli secondary schools, Grades 7 to 10. Fewer spelling errors were reported for each group, although differences did not emerge on achievement measures.

**Summary of Computer Spelling Investigations**

Nine investigations of spelling CAI, five single-subject and four group designs, were described. Eight of nine studies reported positive effects following CAI for the following:

- Presenting individual spelling instruction;
- Presenting constant time delay;
- Enhancing positive attitudes toward computer practice activities;
- Increasing on-task rates during practice activities;
- Providing error imitation and modeling.

Practical considerations regarding CAI interventions include the availability of computers in individual classes, the cost of commercial software, and the teacher time required to obtain and implement these programs. Classrooms with limited access to computers may find CAI spelling programs to be unrealistic.

**FINDINGS FOR STUDENT STUDY TECHNIQUES**

Students' independent study of unknown words is critical to improved spelling performance (Graham, 1983). Unfortunately, students with LD frequently fail to employ efficient study strategies without specific reminders to do so (Graham & Freeman, 1985). Investigations of study techniques described next include two peer tutoring, six directed study, and three self-monitoring (see Table 4).

**Peer Tutoring**

Two investigations of peer tutoring have been conducted in mainstream spelling classes. In the first study (Mandoli, Mandoli, & McLaughlin, 1982), an 11-year-old boy improved his mean spelling scores on seven biweekly tests from 61% correct (baseline) to 78% correct (PND = 90%). This study employed an AB design, which offers limited control regarding internal validity. However, additional support for peer tutoring was provided in the second study by Delquadri, Greenwood, Stretton, and Hall (1983). Subjects were 6 minority students with LD and 18 non-LD minority students from a low-SES, inner-city school. In this ABAB design, peer tutoring combined with social reinforcement, distributed practice, and error correction resulted in spelling errors being reduced from a mean of 9 during baseline to 2.5 (PND = 100%). This research suggests that peer tutoring may be a viable alternative to traditional practice activities in mainstream classes. However, it is not possible to determine the relative effectiveness of the peer tutoring component of this combined intervention package.

**Systematic Study**

This section describes six interventions of specific study strategies for spelling. In the first study, Frank, Wacker, Keith, and Sagen (1987) compared individual (I) to small group (G) instruction of a 5-step procedure (i.e., trace, write, check, reinforce, or correct), employing a single-subject design. Subjects were 4 students (3 girls and 1 boy), ages 9 to 11, referred for severe spelling difficulties. Similar student performance was achieved under each instructional condition on: (a) daily tests (94% correct, PND = 100%); (b) a 1-day delayed posttest (34% correct, I; 26% correct, G); and (c) a paragraph dictation measure (49% correct, I; 54% correct, G). This investigation was conducted in a resource room; the teacher evaluated the group condition as time effective and usable.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample size and ages</th>
<th>Procedures</th>
<th>Intervention</th>
<th>Results</th>
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</thead>
<tbody>
<tr>
<td>Bendell et al.</td>
<td>50 boys with LD; age range = 13-15 yrs., grades 7-9; LD with either an external or internal locus of control</td>
<td>High structure with reinforcement (trace once, write 3 times, and whisper letters) vs. low structure with reinforcement (independent study)</td>
<td>2 sessions; 15 min. each</td>
<td>High structure &gt; low structure for external locus of control Low structure = high structure for internal locus of control</td>
</tr>
<tr>
<td>Delquadri et al.</td>
<td>6 with LD; 18 non-LD; (11 boys, 13 girls); Grade 3</td>
<td>Peer tutoring, social/token reinforcers, team competition, distributed practice, and error correction</td>
<td>27 weeks; 15-min. sessions</td>
<td>Non-LD and LD improved over baselines (PNDs = 100%)</td>
</tr>
<tr>
<td>Foster &amp; Torgesen</td>
<td>Boys: 16 with LD; 8 non-LD; M age = 10 yrs. LD groups were LD with poor (LD-S, n = 8) or normal (LD-N, n = 8) short-term memory</td>
<td>Free-study group (study-quiz format) vs. directed-study condition with modeling, use of spelling panel, review, check, and positive praise</td>
<td>1; 45-min. sessions</td>
<td>LD-S &lt; LD-N under directed- and free-study conditions LD-N scored higher under the directed-study condition</td>
</tr>
<tr>
<td>Frank et al.</td>
<td>4 with LD; (3 boys, 1 girl); M age = 10 yrs.</td>
<td>Positive reinforcement with a 5-step word study practice strategy (trace, write, check, reinforcement, correct) under either group-only or group-plus-individual study conditions</td>
<td>Group conditions had 6 sessions; group-plus-individual had 15 sessions</td>
<td>NSD between conditions but both conditions &gt; baseline (PND = 100%)</td>
</tr>
<tr>
<td>Graham &amp; Freeman</td>
<td>40 with LD; (32 boys, 8 girls); M age = 10.8 yrs.</td>
<td>5-step study strategy (say, write + say, check, trace + say, write from memory and check), employed in 3 experimental conditions</td>
<td>3 sessions; 80 min. each</td>
<td>3 study conditions &gt; free-study (ES = .78) NSD among study conditions</td>
</tr>
</tbody>
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<thead>
<tr>
<th>References</th>
<th>Sample size and ages</th>
<th>Procedures</th>
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<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harris (1986)</td>
<td>4 with LD and attention problems (2 boys, 2 girls); 9–10 yrs.</td>
<td>Alternated monitoring either task productivity or attention to task with the 5-step study procedure (look, spell, study, cover, and write 3 times)</td>
<td>45 sessions; 15 min. each</td>
<td>On-task improved under both conditions</td>
</tr>
<tr>
<td>Harris et al. (1988)</td>
<td>Same as Graham &amp; Freeman (1985), with analysis of spelling accuracy predictions</td>
<td>Same procedures as Graham &amp; Freeman (1985)</td>
<td>3 sessions</td>
<td>Teacher monitored = higher accuracy than free study</td>
</tr>
<tr>
<td>Harris et al. (in press)</td>
<td>4 with LD and attention problems (3 boys, 1 girl); 9–11 yrs.; Grades 4–5</td>
<td>Word-study strategy instruction taught in a counterbalanced multiple baseline design of self-monitoring of attention and self-monitoring of performance</td>
<td>4 days per week; 15 min. per day</td>
<td>Replicated Harris (1986)</td>
</tr>
<tr>
<td>Mandoli et al. (1982)</td>
<td>1 boy with LD; 11 yrs; Grade 6</td>
<td>Peer tutor with flashcard games</td>
<td>2-week baseline; 5-week intervention; 15-min. daily</td>
<td>Baseline condition = 61%; intervention condition = 78% (PND = 90%) average on 7 weekly tests</td>
</tr>
<tr>
<td>Pratt-Struthers et al. (1983)</td>
<td>9 with LD (4 boys, 5 girls); M age = 10.8 yrs.</td>
<td>Copy, write + check instruction on individualized lists from journal misspellings</td>
<td>NR</td>
<td>Baseline condition = none correct; treatment conditions = 90% and were generalized to writing (PND = 100%)</td>
</tr>
<tr>
<td>Reid &amp; Harris (1993)</td>
<td>28 with LD and attention problems; 9–12 yrs.</td>
<td>Spelling study strategy (SSP) training in 1st week followed by counterbalanced self-monitoring of performance (SMP)</td>
<td>4-week intervention; no intervention in the 3rd week</td>
<td>On task behavior: SMA, SMP &gt; SSP (ES = .86); average number of correct practices: SMP &gt; SSP (ES = .47); Weekly spelling tests: SSP &gt; SMA (ES = .42); 10-day maintenance measure SMA, SSP + SMP (ESs = .51, .55)</td>
</tr>
</tbody>
</table>

Note. NR = not reported; NSD = no significant difference; ES = effect size; PND = percentage of nonoverlapping data; LD = learning disability.
In the second study, Graham and Freeman (1985) compared effects of differing levels of teacher direction as students employed a 5-step strategy (say, write and say, check, trace and say, write and check). Forty students (32 boys and 8 girls; \( M \) age = 10.8 years) were randomly assigned to one of three experimental conditions (teacher-directed, teacher-monitored, student-controlled) or to a free-study control condition. Each of the three study conditions resulted in higher posttest scores than the control condition, with no significant differences among conditions (ES = .78).

In the third study, Harris, Graham, and Freeman (1988) conducted further analyses on the data described in the previous paragraph to examine the relationship between students' predictions of correct spellings and test performance. A significant relationship was found between prediction accuracy and test performance. Subjects in the teacher-monitored condition predicted more accurately than did subjects in the free-study condition.

Add-a-Word Instruction. In the fourth study, Pratt-Struthers, Struthers, and Williams (1983) implemented a 3-step study strategy (i.e., copy, write from memory, compare) with the Add-a-Word program (McGuigan, 1975). Subjects were 9 students (4 boys and 5 girls; ages 10 to 11) receiving resource services for poor spelling. Target List 1 was selected from a spelling basal text, whereas subsequent lists were selected from students' misspellings in daily journal writings. A strength of this study is that improvement was documented from baseline (none correct) to a written composition task (90% correct, PND = 100%). Generalization to written composition, the real-world context most pertinent to spelling, has generally been neglected by researchers.

Within-Subject Variables. The final two investigations in this section compared subjects' performances under differing study conditions. In the fifth study, Bendell, Tollefson, and Fine (1980) explored the relationship between levels of study structure, locus of control, and students' spelling performance. Subjects were 50 male adolescents, ages 13 to 15, from an urban school. Each was assigned to an external or internal locus-of-control group, depending on whether he attributed outcomes to external (e.g., luck or other persons) or to internal (e.g., effort and self) causes. Subjects studied target words under high-structure (HS; given specific study directions) and low-structure (LS; independent study with reinforcement) conditions. A significant interaction was obtained. Students with external locus-of-control orientations demonstrated better spelling performance under HS than under LS conditions (79% correct compared to 65%), whereas students with internal locus-of-control orientations demonstrated similar performance under each condition (i.e., LS, 87% correct; HS, 84% correct).

In the sixth study, Foster and Torgesen (1983) compared directed-study versus free-study conditions with three groups of 8 subjects: LD with poor short-term memories (LD-S), LD with normal short-term memories (LD-N), and a nondisabled comparison condition. The subjects were 24 boys (15 White and 5 African American; \( M \) age = 10 years). Each group alternated directed and free-study conditions on eight 4-word study trials with plaster letter chips. No significant differences were found between study conditions. As might be expected,
non-LD students learned greater numbers of target syllables across conditions, whereas LD-S students retained the fewest target syllables under each condition. A significant interaction resulted on the delayed posttest, indicating that LD-N subjects spelled more target syllables correctly under the directed study condition (37%) than in the free-study condition (20%). These final two studies suggest that intrasubject factors may affect the degree to which students with LD may benefit from directed-study methods.

Self-Monitoring. Three similar investigations by Harris compared self-monitoring of attention (SMA) to self-monitoring of productivity (SMP) for on-task behavior and spelling productivity (i.e., numbers of written practices). In the first study (Harris, 1986), subjects were 4 students (2 boys and 2 girls) with severe attention and productivity problems from self-contained special classes. Employment of a 5-step study resulted in improved on-task behavior from 46% (baseline) to 88% during the SMA phase and 63% during the SMP phase. Written practices increased from 22 (baseline) to 36 during SMA and 69 during SMP. Each monitoring condition resulted in improved performance, although decreasing trends in productivity were evident for 2 of the 4 subjects across conditions. Students graphed productivity only, which represents a possible confound. However, in the second study (Harris, Graham, Reid, McElroy, & Hamby, in press), student graphing was required in each monitoring phase. Four students (ages 9 to 11) with attention difficulties who were in self-contained special classes were the subjects. Results were similar to the earlier study: Students preferred productivity monitoring to attention monitoring, perhaps due to interruptions caused by recorded tones employed within the latter condition. Spelling scores were not collected, however, leaving unanswered questions regarding the relationship between these techniques and performance. This very issue was addressed in a third investigation by Reid and Harris (1993).

In a randomized group design, 28 students with attention difficulties, ages 9 to 12, were taught the 5-step procedure (SSP) combined with counterbalanced phases of attention (SMA) and productivity (SMP) monitoring. With either condition (SMA or SMP), on-task behavior increased from that in the student study phase (ES = .86 for SMA; ES = .53 for SMP). Test scores were lower in the attention-monitoring phase than in the SSP phase (ES = .42). On a 10-day delayed measure, more words were retained from the SMP and SSP phases than from the SMA phase (ES = .51 for SMP; ES = .55 for SSP).

In sum, these results support the efficacy of each type of self-monitoring compared to baseline study conditions. Test scores and student response, however, were most positive following the self-monitoring of productivity. A strength of the self-monitoring studies is that the importance of spelling is emphasized prior to strategy training, which appears to be an essential component for strategy use and transfer.

Summary of Student Study Strategies

Ten investigations (six single-subject and four group designs) and one data reanalysis of student study strategies were described. All of these studies suggest
that systematic study procedures improve spelling performance or on-task behavior over students' traditional independent study methods. Support has emerged for the following:

- Peer tutoring;
- Structured study conditions;
- Add-a-Word instruction with 3-step study;
- 5-step study strategies under individual and group conditions;
- Self-monitoring of attention and of written productions.

In addition, several interventions were conducted in mainstream classes and were viewed positively by teachers and students.

**FINDINGS FOR MULTISENSORY/MODALITY TRAINING**

This section presents two investigations of multisensory spelling instruction and six studies that compared study under varying modalities (see Table 5). The first study employed a longitudinal design (Vickery, Reynolds, & Cochran, 1987) to examine the effects of the MulTi-sensory Approach for Reading, Spelling, and Handwriting (MTARSH) on spelling achievement gains. Two hundred eighty-two students (Grades 1 to 6) with LD or qualified for Chapter 1 reading assistance, and 144 nonremedial students, were the subjects. Significant gains were obtained for students in two of the grade levels. However, a comparison group was not employed, which provided limited control for maturation, history, or attrition effects. An additional weakness was that formal training was provided to only 2 of 14 teachers who implemented the program.

In the second study, M. Brown (1988) compared a complex multisensory program with reduced lists, error correction, and metacognitive training to a traditional control condition. Subjects in this study were 14 male adolescents, ages 12 to 13, with severe spelling difficulties. No significant posttest differences were obtained between the two conditions on the Test of Written Spelling (TWS), either on unpredictable words in lists or paragraphs, or predictable words in lists or paragraphs. Significant differences were obtained on unpredictable words when posttest scores were collapsed across lists and paragraphs (ES = 1.56). Treatment effects did not generalize from isolated words to written paragraphs, in spite of the multifaceted intervention format.

*Modality Studies.* In the first study, Isaacson, Rowland, and Kelly (1987) reported positive effects for using fingerspelling with 12 students, ages 9 to 14, with severe spelling deficits. Following pretesting on the TWS and eight 3-hour training sessions, student-partner pairs were instructed to employ fingerspelling study at home on weekly spelling lists. TWS gains at 6-month and 9-month intervals ranged from 5 months to 2 years. However, this study did not monitor home study sessions through any qualitative or quantitative means. In addition, concurrent spelling instruction possibly affected performance gains, which also threatened the internal validity of this investigation.
<table>
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<tbody>
<tr>
<td>Bradley (1981)</td>
<td>10 backward spellers (9 boys, 1 girl); M age = 9.8 yrs.</td>
<td>4 words were taught with letter tiles (VA), write-and-say letters (SOS) instructions, or a no training control (UT)</td>
<td>4 days; 10 min. per day</td>
<td>For posttest and maintenance test: SOS &gt; VA, UT on the number of words spelled correctly</td>
</tr>
<tr>
<td>Brown (1988)</td>
<td>14 boys with LD; M age = 13 yrs.; Grades 6–7</td>
<td>Graphing, multisensory training, reduced lists, training for transfer vs. traditional instruction</td>
<td>12 sessions; 20–30 min. each</td>
<td>Experimental &gt; control on unpredictable daily word lists and posttest (ES = 1.56)</td>
</tr>
<tr>
<td>Hulme &amp; Bradley (1984)</td>
<td>9 non-LD; 9 with LD; M age = 11 yrs.</td>
<td>Word set studied under 4 conditions: write-and-say letters (VAM), write-and-say word (VM), letter tiles only (VA), or no training control (UT)</td>
<td>4 weeks</td>
<td>All 3 conditions &gt; UT: LD performance: VAM (58%), VM (30%), VA (35%)</td>
</tr>
<tr>
<td>Isaacson et al. (1987)</td>
<td>12 with LD; ages = 9–14 yrs.; Grades 4–9</td>
<td>Fingerspelling instruction and home practice</td>
<td>8 sessions; 4 days per week</td>
<td>Gains were reported for 10/12 subjects</td>
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<tr>
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<tbody>
<tr>
<td>Kearney &amp; Drabman (1993)</td>
<td>7 with LD (4 boys, 3 girls); M age = 11.6 yrs. 24 non-LD</td>
<td>Multiple baseline design with write-and-say intervention at different starting points</td>
<td>9 weeks; 4 days per week; 30 min. per day</td>
<td>M correct for baseline = 59% M correct for intervention = 79%</td>
</tr>
<tr>
<td>Vaughn et al. (1992)</td>
<td>24 with LD (18 boys, 6 girls); M age = 7 yrs. 24 non-LD</td>
<td>Word sets were studied under 3 condition responses: handwriting, tracing, or the computer</td>
<td>4 sessions; 30 min. each</td>
<td>Number of words spelled correctly non-LD &gt; LD NSD among conditions</td>
</tr>
<tr>
<td>Vaughn et al. (1993)</td>
<td>24 with LD (16 boys, 8 girls); 24 non-LD Grades 3–4</td>
<td>Word sets were studied under 3 condition responses: handwriting, tracing, or the computer</td>
<td>11 days; 20 min. each day</td>
<td>Same as Vaughn et al. (1992)</td>
</tr>
<tr>
<td>Vickery et al. (1987)</td>
<td>282 with LD or in remedial reading; 144 non-LD or non-remedial; Grades 1–6</td>
<td>Instruction with MTARSH (multisensory spelling instruction)</td>
<td>4 years; daily instruction for Grade 1 = 25 min.; Grades 2–6 = 55 min.</td>
<td>LD had a significant improvement for Grades 3 and 5; NSD for Grades 4 and 6</td>
</tr>
</tbody>
</table>

Note. NSD = no significant difference; ES = effect size; PND = percentage of nonoverlapping data; LD = learning disabilities.
Three similar investigations compared write-and-say (i.e., kinesthetic and auditory) study with various methods conceptualized as within-subject factors. In the first study, Bradley (1981) compared three study conditions: letter tiles (VA), write-and-say practice (SOS), and an untaught control condition (UT). Subjects were 10 students (nine boys and one girl) with severe difficulties in reading and spelling. Bradley reported a significant difference on the percentage of words learned for the SOS method over the VA and UT conditions.

Hulme and Bradley (1984) extended Bradley (1981) by comparing two write-and-say conditions—letter naming (VAM) and word naming (VM)—to the VA and UT conditions. Nine students (M age = 11 years) with severe reading and spelling deficiencies (3 years behind) and nine nondisabled students in a comparison group were the subjects. On a 4-week delayed test, subjects with LD recalled 58% of the words learned under the VAM condition, compared to 30% correct for the VM condition and 35% correct for the VA condition. In contrast, UT subjects performed equally well across the three study conditions.

More recently, Kearney and Drabman (1993) found significant differences, from 59% correct during baseline to 79% on the posttest, with write-and-say practice in a multiple baseline study. Seven 11-year-olds (4 boys and 3 girls) in a suburban school for students with LD were the subjects. Four subjects were White and 3 were African American; all were of middle SES.

Finally, two studies compared spelling practice under three motoric conditions. Subjects in Vaughn, Schumm, and Gordon (1992) were 24 students with LD (18 boys and 6 girls) who had completed first grade in a lower-middle SES school and 24 students in a nondisabled comparison condition. Subjects with LD learned fewer words than did non-LD subjects across conditions (handwriting, computer, and letter tiles), with no significant differences found among motoric conditions. Vaughn, Schumm, and Gordon (1993) extended these results with 24 subjects with LD (16 boys and 8 girls) in Grades 3 and 4 in middle-SES schools. This investigation differed from the previous study by employing more extensive instructional procedures, a delayed posttest, and student preference interviews. Results were consistent with the earlier study: No differences emerged among motoric conditions (i.e., handwriting, computer, and tracing), and fewer words were learned by students with LD than by non-LD students across conditions. Student interviews revealed that computers were the favorite study medium, although subjects believed that writing and tracing were more beneficial for study.

Summary of Multisensory/Modality Training

One single-subject and seven group investigations were conducted on the effects of multisensory/modality training on the spelling performance of subjects with LD. Six of the eight studies reported positive effects. Overall, support has emerged for the following:

- Multisensory instruction;
- Multisensory instruction within a complex intervention package;
- Write-and-say methods;
- Fingerspelling study.
Two investigations that did not contain an auditory (e.g., letter naming) component resulted in no difference among motoric conditions.

GENERAL DISCUSSION

This body of research documented a range of effective methods for improving the spelling skill of students with LD. First, efficacy exists for instructional procedures of imitation modeling, test correction, constant time delay, analogy training, limited list length, and distributed practice. Second, support exists for CAI programs that present error imitation and modeling, constant time delay, drill and practice activities, and individual instruction. Individual performance summaries in CAI (Hasselbring, 1982) have also been documented as useful for instructional decision making, particularly when combined with error analysis information (e.g., Fuchs, Fuchs, Hamlett, & Allinder, 1991). Third, it seems that effective instruction and student study can occur in various classroom configurations, including individual, peer pair, or group. Fourth, the quality of both guided and independent practice for students can be improved by employing directed study techniques (3-step or 5-step) with self-monitoring for increased on-task behavior. Finally, multisensory programs and write-and-say instruction appear to be beneficial. In sum, nearly all “systematic” instructional techniques can be employed to improve the spelling of students with LD. As a whole, this outcome is very encouraging for the population of poor spellers.

The poor spelling of students with LD may be related to underlying difficulties with language (Torgesen & Kail, 1980) memory (Swanson, 1987), phonological awareness (Wagner, 1986), visual and motor processes (Wallace & McLaughlin, 1988), and/or inefficient study strategies (Graham & Freeman, 1985). Consequently, it appears to be important to address these needs with instruction that considers a developmental sequence, empirically effective instructional techniques, and cognitive strategies. It also may be important to select limited numbers of relevant target words with regard to phonemic regularity, meaningfulness, and familiarity to students. Difficulties may stem not only from irregular spelling patterns, but also from language difficulties that occur at phonemic, orthographic, and semantic levels.

Further, this research base gives us reason to question the wisdom of current trends of whole-language approaches to literacy for this population. It is doubtful that students with LD will “spontaneously” acquire spelling skill from exposure to literature or invented spelling approaches.

What are the limitations of this research? First, spelling has generally been represented as an isolated list-learning task. That is, only two investigations mentioned spelling within the context of proofreading skills or within the larger context of written composition. These are important omissions if spelling is intended to be an integrated component of a meaningful language arts program. Second, the relationship of spelling to dictionary skills and phonics instruction also has not been investigated to date. Third, the motivational aspect of spelling study, such as combining spelling strategy and attribution training, needs to be examined. Fourth, the efficacy of spelling elaborations that highlight the critical part of words (e.g., “She said, ‘Eee’ as she went past the cemetery”; Mastropieri &
Scruggs, 1987) has not yet been investigated. Each of these techniques would seem to warrant investigation and could have additional implications for effective spelling instruction. Finally, only 29% of these studies addressed the issue of skill maintenance, whereas only 21% addressed generalization, either across word lists or from one production mode to another (e.g., computer to pencil-and-paper). Future research is necessary to address these issues.

References


