Editor's Comment:

The purpose of the Interventions section of the journal is to provide professional practitioners with overviews of successful interventions that can be replicated with individuals with learning disabilities. These interventions can be either physiological or psychoeducational and can occur in school settings, clinics, hospitals, homes, communities, or employment sites. The discussion of these interventions generally includes (a) the theory or rationale of the interventions, (b) previous research findings, (c) characteristics of the individuals receiving the interventions, (d) the intervention that was applied, and (e) the criteria used to evaluate its success. The following article by Drs. B. Keith Lenz of the Institute for Research in Learning Disabilities, the University of Kansas, and Charles A. Hughes of the Department of Special Education at Penn State University describes a word identification strategy for use with adolescents with learning disabilities. By using this strategy, 12 students who ranged in age from 13 to 15 years reduced the number of oral reading errors they made. Reading comprehension also increased for most of these students. As a result, this intervention may be effective for other students with learning disabilities when reduction of oral reading errors is the goal in the instruction. —**JLW**

A Word Identification Strategy for Adolescents with Learning Disabilities

B. Keith Lenz and Charles A. Hughes

Students with learning disabilities frequently experience difficulty on reading tasks. This difficulty is heightened for adolescents with learning disabilities who are responsible for reading and understanding materials written at several grade levels above their reading ability. Word identification becomes an increasingly important skill for these students, especially when confronted with unfamiliar, polysyllabic words. The present study investigated the effects of training 12 adolescents with learning disabilities in a word identification strategy, DISSECT. The results indicated that the strategy was effective in reducing reading errors for all subjects. However, it was found that increases in word identification differentially affected reading comprehension and indicate the need for separate and/or simultaneous attention to comprehension processes.

Most secondary students with learning disabilities are mainstreamed for the majority of the school day (up to four classes) and are expected to cope with the same curricular demands as their nonhandicapped peers (Schumaker & Deshler, 1984). A frequent and critical requirement in mainstream classes is to read, understand, and remember information from texts. Since secondary texts are written at reading levels ranging from the 10th- to 17th-grade levels (Schumaker & Deshler, 1984), and the average reading ability level of secondary students with learning disabilities is approximately at the 4th-grade level (Alley & Deshler, 1979; Deshler, Schumaker, Alley, Warner, & Clark, 1982), it may be assumed that many of these students experience serious difficulty mastering information presented in secondary school settings through the reading medium.

One reading skill that is a significant problem for many adolescents with learning disabilities is word identification (Warner, Schumaker, Alley, & Deshler, 1980). Many secondary science and social studies assignments require the student to quickly attack and identify long, unfamiliar words in reading materials. The ability to meet this requirement is important because adequate comprehension of most reading assignments is dependent upon the student's ability to handle the large number of content-specific words. Perfetti (1986) reported that the ability to decode long, polysyllabic words increases the qualitative differences between good and poor readers. Unfortunately, most secondary students with learning disabilities do not have the time or the motivation to be taught the entire sequence of word-attack skills.

The process of word identification can include the use of a variety of strategies by the reader to attack difficult words. For example, the reader might use contextual clues, phonic analysis, or structural analysis. While many adolescents with learning disabilities may have mastered basic phonic skills (i.e., sound-symbol relationships) and may have developed a basic sight vocabulary, they still may experience severe reading problems when required to read material containing unfamiliar, multisyllabic words that is found in high school textbooks (Deshler, Schumaker, Lenz, & Ellis, 1984; Henderson & Shores, 1982; Perfetti, 1986). Good readers are able to identify word components using skills such as syllabication and identification of prefixes and suffixes (Perfetti, 1986). They also appear to adopt automatic and systematic problem-solving strategies for identifying difficult words and incorporating successful word analysis tactics. Conversely, an inability to apply appropriate strategies to reading tasks associated with the acquisition of secondary level materials can contribute to overall school failure. Many of these skills are subsumed in a procedure referred to as *structural analysis*. Structural analysis requires analysis of word units in order to correctly identify and pronounce a word. Word units include prefixes, suffixes, root words, and syllables. Successful readers appear to systematically and consistently apply structural analysis procedures, whereas poor readers do not (Lewis, 1983; Morrison, 1984).

Very little research has been conducted on what constitutes effective procedures for teaching adolescents with learning disabilities how to address the problem of identification of difficult, multisyllabic words in content area materials. For

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example, Henderson and Shores (1982) found that providing a structured format for teaching suffixes was effective in increasing oral reading performance. However, this study examined only one aspect of the word identification problem, and no other studies related to teaching the process of word identification of multisyllabic words to adolescents with learning disabilities were identified in the literature. However, in studies of younger children, one finding that has implications for instruction in this area is that individuals with reading disabilities are capable of using context to aid word recognition and may even rely on context for speed decoding, more so than individuals with no reading disabilities (Allington & Strange, 1977; Perfetti & Roth, 1980; Spear & Sternberg, 1987; Stanovich & West, 1979).

Word Identification and Strategy Training

One approach that can be employed to assist students in word identification is strategy training. In the past 10 years, a number of strategy training approaches have been implemented by researchers interested in improving the performance of students with learning disabilities and other students performing poorly in school. In general, the goals across strategy training efforts have included teaching, guiding, or prompting the student to "establish goals, select appropriate procedures, and monitor progress towards achieving goals" (Mayer, 1987, p. 418) in order to meet task demands. While research on the strategies of individuals with learning disabilities and their response to strategy instruction has been ongoing since the mid to late 1970s (e.g., Torgesen, 1977; Wong, 1979), the translation of this research into effective teacher practice has been relatively limited. Although interpretations of and orientations to strategy training have been varied (deBettencourt, 1987), a number of intervention efforts have been developed and validated to provide strategy instruction (e.g., Deshler & Schumaker, 1986; Lloyd & deBettencourt, 1982; Palincsar & Brown, 1984).

However, as deBettencourt (1987) noted, strategy training programs are not always similar. For example, Ellis and Lenz (1987) identified a number of factors involved in strategy training. From these reviews, at least three important dimensions emerge that appear to be important to consider when comparing strategy programs. First, strategy training programs often differ in the nature of the strategies being taught. Mayer (1987) contended that there is a distinct difference between a *strategy* and a *procedure.* Mayer stated that a procedure relates to a person's knowledge of the steps or algorithm that can be used in a specific situation. For example, the steps involved in completing a long division problem would be a procedure and not a strategy. A strategy, on the other hand, relates to a person's knowledge of the general approaches to making decisions regarding which procedures should be implemented and modified, and it guides the learning, remembering, and problem-solving processes involved in the application of procedures. Therefore, application of the strategy will ultimately enhance the integration of new knowledge with existing knowledge. On the other hand, a procedure is more step oriented and situation specific. Similarly, a procedure, while being highly related to strategic knowledge, may not be a strategy. The approaches used to teach students strategies (e.g., Deshler & Schumaker, 1986; Lloyd & deBettencourt, 1982; Palincsar & Brown, 1984) often fall somewhere on a continuum between instruction in a detailed procedure and instruction in a strategy.

The second element to consider when comparing strategy programs is that programs differ in how the strategy is "packaged" or designed for presentation to the student for learning. Strategy design may include such features as the use of short, key-action steps, mnemonics to help memorization, and the language used to capture the notions of the strategic process (Ellis & Lenz, 1987). Third, how a person *acquires* strategic knowledge has also been interpreted differently across the various strategy intervention approaches. Current strategy training efforts have approached strategy training primarily through *direct* or *indirect* teaching tactics. The indirect approach focuses on prompting student use of strategies through modeling, questioning, shaping, correcting, and guiding student response to a task. An expert guides the student through the task and, as instruction progresses, gradually guides the student to take responsibility for effective and efficient completion of the task. In general, the student is immersed in a strategic instructional environment. This approach is represented in the reciprocal teaching methods described and validated by Palincsar and Brown (1984). The direct teaching approach focuses on identifying an effective and efficient system for accomplishing a specific task. Once the strategy is identified, the teacher then teaches skill prerequisites, presents the strategy, models and demonstrates the strategy, and provides direct practice and feedback related to the student's application of the strategy. The direct teaching method is represented in the academic strategy training approach described and validated by Lloyd and deBettencourt (1982).

Aspects of all three of these program dimensions have been incorporated in the strategy training program of the Strategies Intervention Model described and validated by Deshler and Schumaker (1988) and colleagues at the University of Kansas Institute for Research in Learning Disabilities. In this program, strategies related to academic, social, and motivational demands have been identified and designed and are taught directly to students (Grades 5 and up) in the context of actual classroom and community demands. However, other components of the program have been developed to create a *model* that serves to address other key factors related to indirect qualities of strategy training, such as creating a strategic classroom environment, promoting modification and adaptation of the strategy to novel tasks, teaching students to generate their own strategies, and defining the role of the content teacher in creating and promoting strategic responses.

A strategy training approach to word identification is based on the premise that teachers can teach students to identify a large number of multisyllabic content area words by first assisting students to conceptualize word identification as a problem-solving process and then providing a set of steps designed to help the student solve the word identification

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problem. As a result, a learning strategy was developed for teaching students a problem-solving strategy related to identifying unfamiliar words in content area materials. The purpose of the present study was to examine the effects of teaching this word identification strategy to adolescents classified as learning disabled. The strategy consisted of a problem-solving paradigm incorporating "likely to work" identification tactics, such as the use of contextual cues, resources, and application of common principles of structural analysis. The strategy training approach employed consisted of a set of procedures for which strategy-related decision rules and guidelines were specified. A direct strategy training orientation was utilized to promote student acquisition of the word identification strategy. Specifically, the study focused on examining whether student acquisition of the strategy would result in a decrease in the number of word identification errors made during oral reading and an increase in overall passage comprehension.

METHOD

Subjects and Setting

The 12 subjects were seventh-, eighth-, and ninth-grade students who met the state of Florida requirements for being classified as learning disabled. The requirements at the time of this study were as specified by Florida State Board of Education Rule 6A-6.3018 and included (a) evidence of a basic psychological process disorder as documented by a standardized instrument selected by the school district; (b) evidence of academic achievement that is significantly below the student's level of intellectual functioning as documented (for ages 11 and above) by a discrepancy of 1½ standard deviations or more between an intellectual standard score and academic standard score in reading, writing, arithmetic, or spelling; (c) evidence that the learning problems are not due primarily to other handicapping conditions; and (d) evidence that indicates that general education alternatives have been attempted and found to be ineffective in meeting the student's educational needs. Subjects attended two different schools (a middle school and a high school) and were served in classes for students with learning disabilities for no more than two periods per day. In addition, subjects were only selected if they met the following criteria: (a) read at or above the third-grade level, (b) had knowledge of phonic sounds, and (c) could find words in the dictionary.

The intervention for the middle school students took place in three different language arts classes designed for students with learning disabilities. The intervention for the high school students took place in three different ninth-grade English classes designed for students with learning disabilities. The total class size in the middle school classes ranged from 8 to 12. The total class size in the high school classes ranged from 7 to 12. Instruction in the strategy took place in instructional groupings ranging in size from 3 to 7 students with learning disabilities. A total of 21 students met the selection criteria. Twelve students were randomly selected as subjects for this study.

Three females and 9 males composed the student sample. Eight of the students were white and 4 of the students were black. Student ages ranged from 13 to 15 years ($\bar{x} = 13.2$ years); 4 were seventh graders, 2 were eighth graders, and 6 were ninth graders. IQ scores (obtained within the last 3 years—Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1974)—ranged from 82 to 113 ($\bar{x} = 94.3$, $SD = 11.3$). Grade level reading scores, as measured by the Woodcock-Johnson Psycho-Educational Battery (Woodcock & Johnson, 1977), ranged from 3.5 to 7.0; reading percentile scores ranged from 7 to 32 ($\bar{x} = 15.7$, $SD = 8.8$); standard scores ranged from 78 to 93 ($\bar{x} = 84.17$, $SD = 9.17$).

Strategy Description

The word identification strategy (Lenz, Schumaker, Deshler, & Beals, 1984) designed for this study is a systematic process through which multisyllabic words can be recognized in reading assignments in content areas such as science and social studies. The intervention consists of training the student in a general problem-solving strategy in which specific substrategies are applied for the quick identification of difficult words. The substrategies, based in part on work presented by Forgan and Mangrum (1976) and Wolf (1974), follow the premise that most words in the English language can be pronounced by identifying prefixes, suffixes, and stems and by following three short syllabication rules. These rules, combined with several other practical approaches to word attack, are embedded in a general problem-solving procedure and make up the seven-step strategy.

The seven steps of the strategy require the student to focus on the context surrounding the word, dissect the word into component parts using simple rules, and use available resources (e.g., teacher, dictionary) if needed. The key words used to teach the steps of the strategy form a first-letter mnemonic device, DISSECT, that can be used to facilitate student memorization of the steps. The first step, Discover the Context, requires the student to skip a difficult word, read to the end of the sentence, and then use the meaning of the sentence to guess the best word that fits in the place of the word in question. If the guessed word does not match the difficult word, the student proceeds to the next step, Isolate the Prefix. In this step, the student is taught to look at the beginning of the word to see if the first several letters create a phoneme that the student can pronounce. A list of prefixes is taught to the student to facilitate recognition. If a prefix is recognized, it is isolated by *boxing* it off (e.g., *hyper*| sonic). Using similar procedures and a list of suffixes, students then Separate the Suffix. Whether or not the word contains a suffix, students proceed to the fourth step and Say the Stem. Students are taught that the stem is what is left after the prefix is *isolated* and the suffix is *separated.* If the stem is recognized, the student says the prefix, stem, and suffix together. (Note: For the purposes of this strategy, the terms *prefix* and *suffix* are broadly defined as any recognizable group of letters at the beginning or end of a word that the student can identify and pronounce correctly.) If the stem *cannot* be named, the student proceeds to Examine the Stem. This step involves dissecting the stem into easy-to-pronounce word parts using the Rules of Twos and Threes. The

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first rule is: If a stem, or any part of a stem, begins with a vowel, separate the first *two* letters and pronounce, *or* if the stem, or any part of the stem, begins with a consonant, separate the first *three* letters from the rest of the stem and pronounce them. Once the first two or three letters are separated from the stem, the application of the same rules is repeated until the end of the stem is reached (e.g., *al*|ter|na|*tor*). The stem is then pronounced by saying the dissected parts. If the stem can be read, the prefix and suffix are added and the whole word reread. If the student cannot use Rule 1, the second rule is applied. Here, the student isolates the first letter of the stem and then tries to apply the first rule again. Rule 2 is especially useful when a stem begins with two or three consonants. The third rule, which can be used in conjunction with either of the previous rules, is applied when two different vowels appear together in a word. The student is instructed to pronounce both of the vowel sounds in the word. If that does not "sound" right, the student makes one vowel sound at a time until it sounds right.

If the first five strategy steps have been tried, and the student still cannot pronounce the word, the student is told to Check With Someone (e.g., teacher, parent, better reader) in an appropriate manner (e.g., politely, without interrupting, not too many times). If someone is not available or if the assistance is judged incorrect, the student is then taught to Try the Dictionary. The student looks up the word, uses the pronunciation guide to pronounce the word, and reads the definition if the meaning of the word is unknown.

Measurement

Five measures were used in this study; there were three oral reading measures and two reading comprehension measures. The first oral reading measure consisted of reading a 400-word passage written at each of the students' reading levels (as indicated by a standardized achievement test) selected from the Timed Readings series (Spargo & Williston, 1980). Therefore, the reading level of the passages varied across students. The second oral reading measure consisted of 400-word passages taken from the Timed Readings series, written at each student's grade level. Therefore, depending on the grade level, students were given passages at either the seventh-, eighth-, or ninth-grade level. The third oral reading measure consisted of a passage selected from the student's science textbook used in his or her mainstream science class. This oral reading measure was used only for the generalization probes. Each of the two comprehension measures consisted of a 10-question, paper-pencil, multiple-choice format test covering the main ideas and details of each of the 400-word passages. The first comprehension measure covered information from the ability-level reading passages. The tests were from the Timed Readings books. The second comprehension measure covered information from the grade-level passages. A comprehension measure was not obtained during the generalization probe.

The general procedure used for administering all of the oral reading measures consisted of subjects reading a 400-word passage into an audiotape recorder. On the following day, without review of the reading material, students were given the 10-question, paper-pencil, multiple-choice format comprehension test. Each student's taped reading was then scored for errors using a copy of the passage as a scoring sheet. Each word error made by the student was circled. Mispronunciations (according to a standard English dictionary), omissions, and substitutions for the word in the passage were counted as errors. Mistakes made in words of three letters or fewer, words that were mispronounced and then corrected, words that were inserted, and word-order changes were not counted as errors. Percent-correct scores were calculated by dividing the total number of words read correctly (the total number of words in the passage minus the number of words missed) by the total number of words in the passage. Since each passage was approximately 400 words in length, a mastery criterion of 99% words correct was set, which meant that the student could miss no more than six words in order for the mastery criterion to be met. Mastery was determined when the student met the criterion on any single trial. The comprehension test was scored according to the answer key in the Timed Readings book, and then the score was converted to a percentage.

Interscorer agreement was determined for 10% of the trials on the audiotapes by having two independent scorers listen to the tapes and score the students' oral reading performance. The recordings were compared item by item, then the percentage of agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. Total agreement on individual performance ranged from 92% to 100%, with a mean total agreement of 97%.

Teacher Training

The word identification strategy intervention was delivered to the subjects by one middle school and one high school teacher who had been trained in the strategy by the investigators. Each teacher received 3 hours of training in an overview of the learning strategy instructional approach as operationalized in the Strategies Intervention Model (Deshler & Schumaker, 1988) and 6 hours of specific training and scoring practice in the word identification strategy. In addition, as part of the training process, both teachers had previously taught the strategy to students with learning disabilities to mastery and had been observed and been provided feedback on critical teaching behaviors involved in the delivery of the steps of the strategy and application of the instructional procedures.

Instructional Procedures

The word identification strategy was taught to the students by their teachers using an eight-step instructional sequence that was originally described by Deshler, Alley, Warner, and Schumaker (1981) for promoting strategy acquisition and generalization. The procedures (see Note) were as follows.

Step 1: Pretest and Obtain Commitment to Learn. During this step, each subject's word identification skills were measured using 400-word passages from Timed Readings (Spargo & Williston, 1980). Subjects' reading skills were measured at both ability and grade level. After the oral reading and comprehen-

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sion tests were scored, the results were discussed with each student individually and a written commitment to learn the strategy was obtained from the student.

Step 2: Describe the Strategy. Next, each student participated in a goal-setting discussion and specified goal dates for completing various phases of the strategy training. The strategy steps were then described in detail. In addition, the general characteristics of situations where the strategy could be used, as well as the types of benefits students could expect if they learned and applied the strategy, were described. Also described were general guidelines or cautions related to the use of the strategy, such as (a) the strategy works best on reading assignments that follow a teacher's description of the content in class, (b) the first five steps of the strategy usually will not work on vocabulary words to which the student has not been introduced, and (c) the strategy should be learned to such a level of fluency that no more than 10 seconds are required to complete the first five steps.

Step 3: Model the Strategy. In this instructional step, the strategy was demonstrated in its entirety, with the teacher thinking aloud so subjects could witness all of the processes involved. A script was used to ensure appropriate teacher modeling. However, the teacher was encouraged to expand on the script if additional modeling was necessary. Once the teacher modeled the strategy, the students were then enlisted in the modeling process. Students were asked to demonstrate the strategy, using materials written slightly above the students' reading level. The teacher guided and prompted the students to think aloud, demonstrate appropriate self-instruction behaviors, ask and answer appropriate "what next" questions, and explore solutions to the word identification problems they encountered.

Step 4: Verbal Rehearsal of Strategy Steps. During this step, subjects verbally rehearsed the strategy steps (including the Rules of Twos and Threes). First, each student described the general nature of the strategy and the problem-solving process in his or her own words. Second, each student described each step of the strategy and what was involved in each step of the problem-solving process. Third, after each student demonstrated an understanding of the strategy steps, a rapid-fire oral practice of the steps was led by the teacher to assist students in memorizing the steps. A criterion of 100% correct had to be reached in order to proceed to Step 5: Controlled Practice and Feedback. Also, subjects were required to pronounce correctly at least 80% of the prefixes and suffixes provided to them in a list of 56 prefixes and 54 suffixes. Students had been introduced to the list of prefixes and suffixes in their language arts classes earlier in the year, and mastery of the list was demonstrated very quickly.

Step 5: Controlled Practice and Feedback. Subjects practiced the strategy while orally reading into a tape recorder passages from the Timed Readings series. Passages used during this step were written at each subject's reading ability level. During the early stages of controlled practice, assistance was provided to the student on up to five of the initial trials to insure that the strategy was being applied correctly. During these practice sessions, each student was prompted to think aloud, demonstrate self-instruction behaviors, and ask and answer "What do I do next?" and "Does this work?" types of questions. The teacher would provide assistance and feedback to students on an individual basis to insure that each student was using the strategy in a problem-solving fashion. These guided practice sessions were not considered independent practice trials and were not graphed as progress data. When subjects could independently read a passage with six or fewer oral errors (i.e., 99% correct), they began Step 6. (Note: Throughout the testing and practice sessions, the student was allowed to appropriately ask for help on up to three different words in order to learn use of all the steps of the strategy. If the student requested help on three words, these words were not included in the computation of the percentage of words correctly read.) After each practice attempt, the student was provided with corrective feedback related to how he or she did and how to correct specific errors and improve general performance.

Step 6: Grade-Appropriate Practice and Feedback. During this step, subjects practiced the strategy while orally reading Timed Readings passages written at the grade level in which they were enrolled. During the early stages of grade-appropriate practice, assistance was provided to the student on up to five of the initial trials to insure that the strategy was being applied correctly to these more difficult reading materials. During these guided practice sessions, the difficulty of the reading passages was gradually increased until the student was practicing the strategy on grade level materials. These guided practice sessions were not considered independent practice trials and were not graphed as progress data. Practice was infused within the context of daily lessons and other assignments in the language arts and English classes. When subjects could independently read a passage with six or fewer oral errors (i.e., 99% correct) in the grade level passages, they were given the posttest. Specific corrective feedback was provided to the student after each practice attempt. Feedback consisted of information related to adherence to the problem-solving process as well as to overall word identification performance.

Step 7: Posttest and Obtain Commitment to Generalize. The final grade level practice attempt was used as the posttest for the intervention, since the procedures for the posttest paralleled the pretest and grade level practice procedures. Once all students had met the mastery criterion (had independently read a passage with six or fewer oral errors in the grade level passages), a written commitment was obtained from each student to generalize the word identification strategy to school and home situations.

Step 8: Generalization. Generalization activities were organized into three phases. The first phase, called *Orientation,* involved teachers leading the students in identifying settings where the word identification strategy could be used and then helping students to plan ways to remember the use of the strategy in those settings. The second phase, called *Activation,* consisted of trial attempts and reports of strategy usage across various settings, situations, and materials.

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The third phase, called *Maintenance,* consisted of planned use of the strategy over time in classroom situations. Generalization probes of student performance were taken intermittently and only during the Maintenance phase.

A generalization probe consisted of the subject orally reading two 400-word passages into a tape recorder. The first passage was selected from the Timed Readings series written at the student's grade level. The second passage consisted of an unfamiliar selection from the textbook used in the student's mainstream science class. A comprehension measure was obtained only on the Timed Readings selection. Comprehension measures were not taken from the grade level text because of the difficulties in standardizing the measures across teachers and texts. The probes were conducted 1 week, 3 weeks, and 5 weeks after completion of the strategy posttest on grade level materials. The students were informed of the schedule for the probes and expectations as soon as the Activation phase activities were completed, and then they were reminded of the probe the day before each probe was given.

In general, the average amount of time spent on strategy instruction throughout the instructional sequence (Step 1 through Step 7) was approximately 20 to 25 minutes per day for a 6-week period. Instructional time for the strategy was allocated in the language arts or English classes at least 3 days each week, but was usually provided daily in the context of a classroom situation when other types of instructional activities were required.

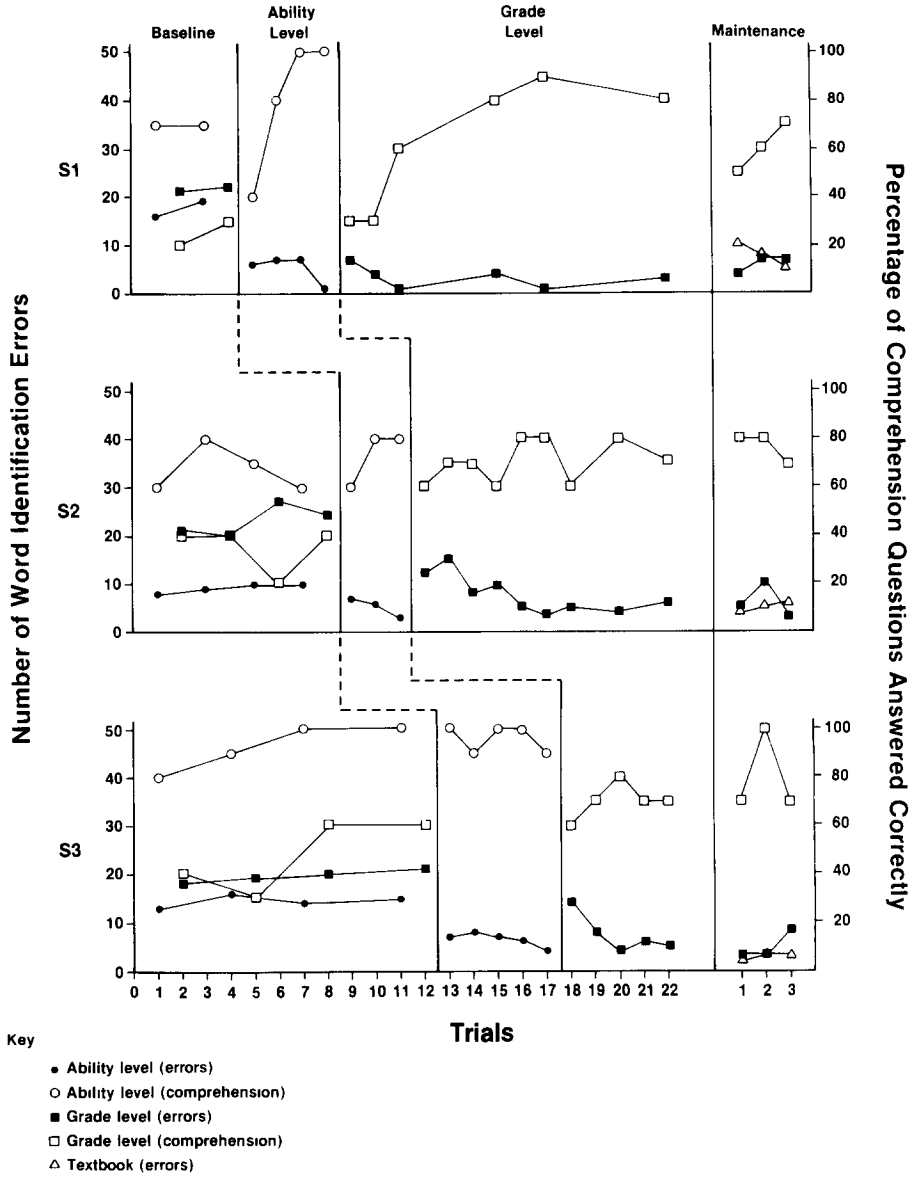

Figure 1. Number of word identification errors and percentage of comprehension questions answered correctly for Subjects 1, 2, and 3.

Experimental Design

A multiple-baseline across subjects design (Baer, Wolf, & Risley, 1968) was employed and replicated three times. Three students participated in each design. The first subject in each group of three students received a minimum of two pretests on materials written at ability and grade levels prior to instruction. The second subject in each group received a minimum of four pretests. The third subject in each group received a minimum of four pretests. Training was instituted only after baseline data were stable.

RESULTS

Figures 1 through 4 show baseline, training, and maintenance results on ability level and grade level materials for all 12 subjects. Oral reading errors on ability level Timed Readings passages are depicted with closed circles, and the corresponding comprehension scores for those passages are depicted with open circles. Oral reading errors on grade level Timed Readings passages are depicted with closed squares, and the corresponding comprehension scores for those passages are depicted with open squares. Oral reading scores for the grade level science textbook passages are depicted with triangles. The scale on the left side of each figure indicates the number of reading error scores; the scale on the right side of each figure indicates the percentage of comprehension questions answered correctly.

The oral reading results collected during baseline indicate that the number of oral reading errors was higher for grade level materials than ability level materials for all subjects. Four subjects (6, 7, 10, and 12) made six or fewer errors (99% correct oral-reading criterion) in ability level materials. The remaining subjects' mean baseline performances ranged from 6.3 to 20.5 errors on the ability level materials. The baseline performance of

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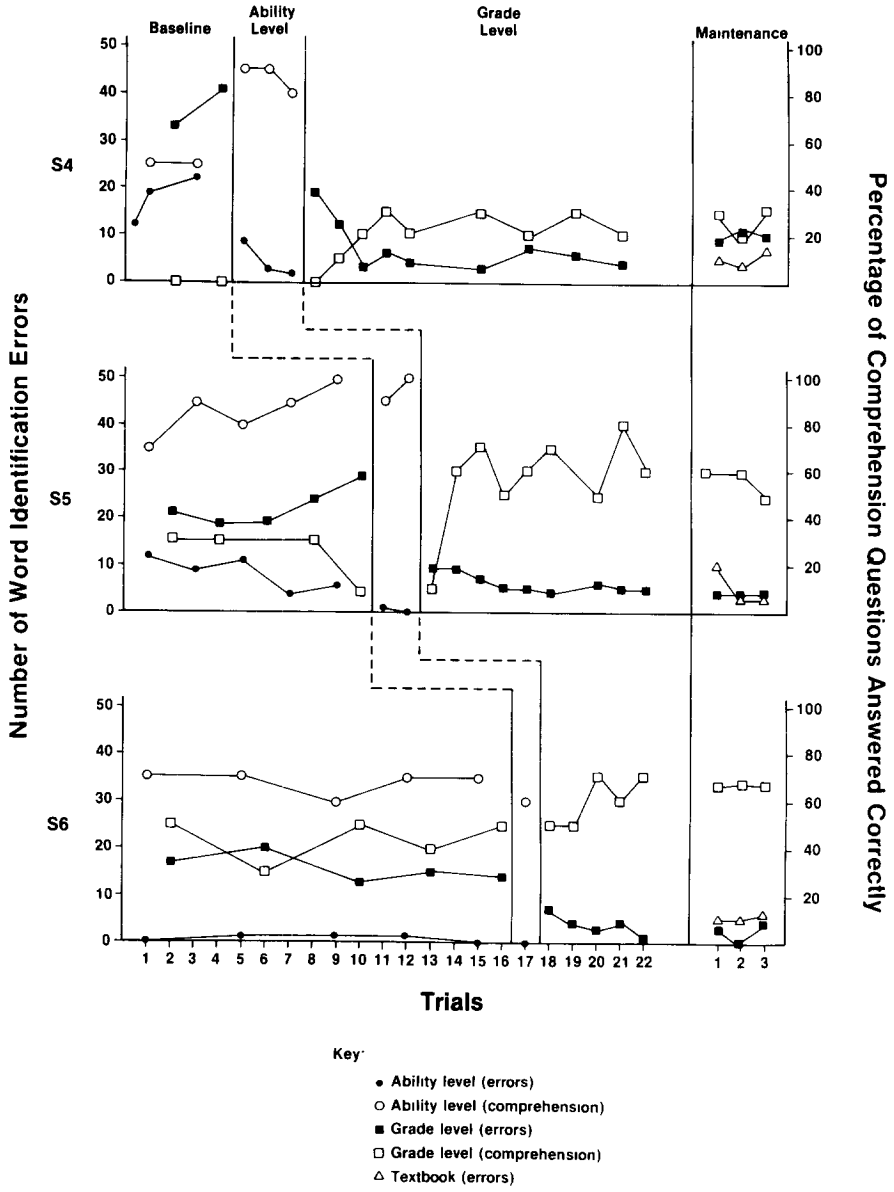

Figure 2. Number of word identification errors and percentage of comprehension questions answered correctly for Subjects 4, 5, and 6.

all subjects on grade level materials ranged from 12.6 to 37.0 errors.

The frequency of oral reading errors on ability level materials decreased after strategy instruction for the subjects who did not meet the 99% criterion during baseline (Subjects 1, 2, 3, 4, 5, 7, 8, 9, 11). The four subjects who had met the 99% criterion during baseline demonstrated no errors in ability level materials during the ability level training condition. All subjects reached the mastery criterion (6.0 or fewer errors) in ability level materials within five independent practice attempts. The mean number of errors across subjects ranged from 0 to 6.4 errors in the ability level materials.

When training was instituted for grade level materials, a decrease in errors also occurred. All subjects met the mastery criterion (6 errors or fewer) in grade level materials within nine independent practice attempts. The mean number of errors across subjects ranged from 2.9 to 8.3 errors for the grade level materials.

The mean comprehension scores during baseline ranged from 50% to 100% with a mean of 83.13% on ability level materials and from 0% to 80% with a mean of 38.72% on grade level materials. The mean comprehension scores for the ability level training condition ranged from 60% to 100% with a mean of 88.21% on the ability level materials. The mean comprehension scores for the grade level training condition ranged from 20% to 74.3% with a mean of 58.31%.

The results of the three generalization probes show maintenance of student performance levels consistent with those achieved during grade level training on both the oral reading and comprehension measures obtained with the Timed Readings selections. All oral reading scores collected during the maintenance phase are better than those scores obtained before training. Also, all grade level comprehension scores collected during the maintenance phase are better than those earned before training, with the exception of Subject 7's scores, which were at the 80% level in grade level materials during baseline. In addition, scores based on oral reading performance on the students' actual classroom textbooks are similar to those scores from the Timed Readings selections.

DISCUSSION

Training in the word identification strategy was effective in reducing common oral reading errors such as mispronunciations, substitutions, and omissions for the subjects in this study. Three replications of a multiple-baseline, across-subjects design demonstrated that improvement occurred only after each subject received instruction in the strategy. Significant changes occurred in student performance within a relatively short period of time (6 weeks). The number of errors decreased for each subject in both ability level and grade level materials. In addition, comprehension of ability level and grade level materials increased. Performance levels were maintained for 5 weeks after training was discontinued.

Another significant element of this study relates to the fact that instruction took place within the context of six language arts classrooms where other types of instructional activities were typically required. While these classroom situations were designed for individuals with learning disabilities, all of these classes had been designed to teach language arts content consistent with performance standards and outcomes specified by the school district as leading to the minimum requirements for high school graduation.

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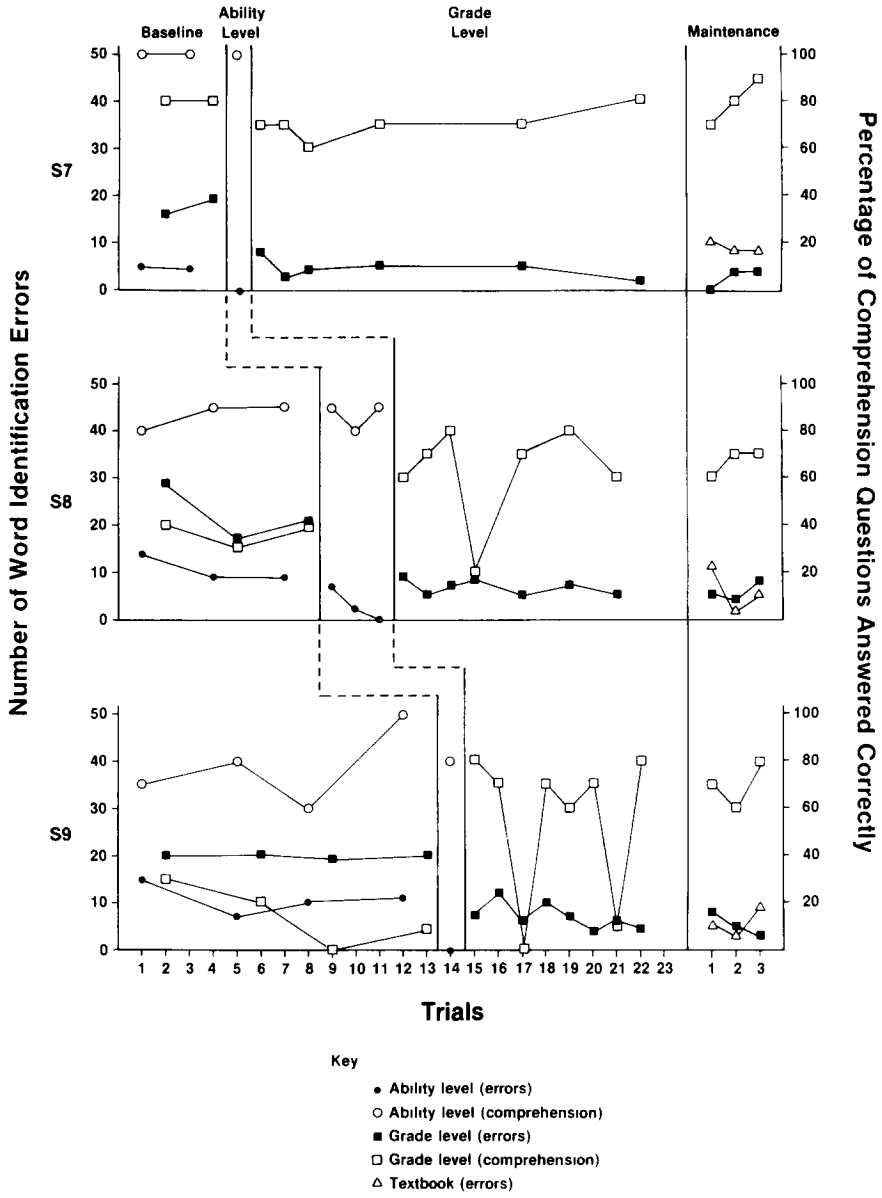

Figure 3. Number of word identification errors and percentage of comprehension questions answered correctly for Subjects 7, 8, and 9.

A combination of teacher-directed and independent seat work instruction arrangements, combined with appropriate activity rotations and management systems, enabled the intervention to be infused into the six language arts classes with positive results. This finding indicates that it is possible to successfully infuse instruction in the word identification strategy into typical course structures and, specifically, into specialized language arts courses.

Despite these positive findings, there are a number of concerns and cautions that need to be addressed. First, not all subjects demonstrated a substantial increase in comprehension as a result of the training. While most of the subjects demonstrated improved comprehension, one subject's (Subject 4) comprehension scores during maintenance did not approach what would be considered a passing score in secondary school classrooms, and other subjects' scores hovered near the passing level.

Second, inconsistent gains in comprehension performance were demonstrated by some of the subjects. A decrease in comprehension scores was noted in conjunction with the initial application of the word identification strategy on grade level materials for Subjects 1, 7, and 11; however, the reading comprehension scores for these subjects eventually increased as fluency in the strategy was achieved. In addition, the training did not appear to affect the grade-level comprehension performance of Subject 7 between baseline and maintenance. However, as the comprehension level of Subject 7 was acceptable prior to training (80%), overall gains in this area were less likely. This result must be weighed in light of the benefits that might potentially be achieved by the significant reduction in oral reading errors made by Subject 7 between baseline ($x = 17.5$) and the grade level training condition ($x = 5.1$). This would indicate that a teacher should not expect large increases in reading comprehension by increasing word identification in students with high reading comprehension scores prior to instruction.

These comprehension score results indicate that for some students the word identification strategy might address only the reading problem of word identification and may not have an impact on comprehension. Increases in some of the comprehension scores were minimal or erratic. In fact, four patterns of comprehension emerged among these 12 students in response to the word identification strategy intervention: (a) Comprehension increased commensurate with an increase in word identification proficiency; (b) comprehension increased minimally with an increase in word identification proficiency; (c) comprehension was negatively affected by an increase in word identification proficiency, but recovered as word identification instruction continued; and (d) intact comprehension was negatively affected by an increase in word identification proficiency and, at least in the short term, was not affected by continued training in the word identification strategy. This finding appears to be consistent with other research on word identification training that indicates that the use of context and other word identification techniques requires additional processing that can initially inhibit student attention to the use of appropriate comprehension strategies (Spear & Sternberg, 1987). Specifically, Perfetti and Lesgold (1976) have argued that coding of word information into short-term memory is less efficient and effective in the less skilled comprehender and that this inability to hold information in short-term memory causes a "bottleneck" for higher

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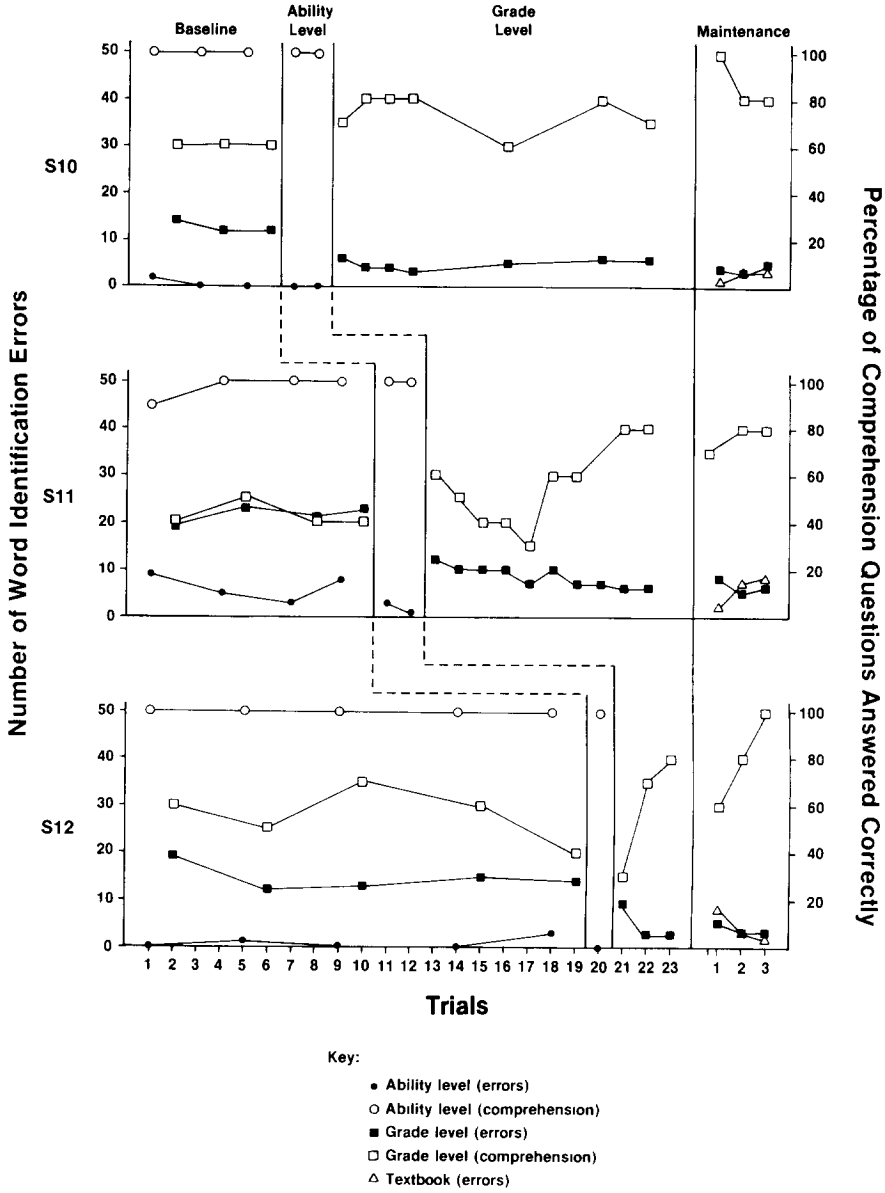

Figure 4. Number of word identification errors and percentage of comprehension questions answered correctly for Subjects 10, 11, and 12.

order processing of information. It may be that a number of students need to reach a certain level of automatization in the use of the word identification strategy and then need to be taught additional comprehension strategies, while other students need to be taught word identification strategies in conjunction and simultaneous with appropriate comprehension strategies.

Third, while the maintenance probes indicate that the word identification strategy was a likely factor in reducing oral reading errors in regular class textbooks, since no baseline data were collected from materials taken from the students' science books, the impact on actual classroom performance must remain speculative. However, since the Timed Readings selections were based on the students' grade level, and the intervention effects were maintained 5 weeks after instructions, it can be concluded that the intervention has tremendous generalization potential.

Fourth, the teachers who provided the intervention to the subjects in this study had received a significant amount of training prior to the beginning of the study. While the intervention was effective, replication of the intervention may be limited to those teachers who have been trained and had practice in the specific acquisition and generalization steps related to teaching task-specific strategies, or have access to training in the strategy. This factor, combined with the limited sample size, indicates that additional replications of the intervention across a wide variety of teachers and subjects would be appropriate and helpful.

Fifth, the positive results of this type of training support contentions of others (e.g., Henderson & Shores, 1982; Lewis, 1983; Perfetti, 1986) that direct, structured teaching of word identification tactics can be effective. However, this study supports the efficacy of such instruction only when it is provided within a problem-solving strategy framework. In this case, the word identification tactics were infused within the framework of a multistep learning strategy. The claim that it was the problem-solving orientation to the use of the word identification tactics that facilitated performance can only be made if the students actually used the problem-solving process to identify the unknown words. Since decision making is a cognitive process that cannot be directly observed, student adoption of a problem-solving approach can only be inferred based on demonstration of observable behaviors. In this study the behaviors included (a) the student "think aloud" behaviors demonstrated in response to prompts by the teacher, and (b) the physical behaviors actually cued and prompted by the strategy.

Throughout the instructional process, the students demonstrated that they understood and were applying the strategy in a problem-solving manner in a number of ways. First, during the modeling step, the "think aloud" behaviors were first modeled by the teacher using a script. The students were then prompted to demonstrate the strategy using this "think aloud" process. Students were also prompted to "think aloud" during the guided practice portion of each of the two practice phases. Each time the student was asked to "think aloud," the teacher provided feedback and guidance to insure that the student correctly followed the problem-solving process required by the strategy. Second, during the verbal rehearsal stage, each student had to reach mastery in describing the problem-solving process and then mem-

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orize the remembering system that had been designed to prompt student use of the problem-solving process. And third, during the independent practice trials, teachers reported that each student was observed identifying unrecognized words corresponding to the use of all the steps of the strategy. This observation indicates that the students were searching and finding alternatives presented by the word identification strategy steps. Evidence for these observations was generated from student verbalizations on the audio tape recordings, word division marks on words in the passage or on scraps of paper, asking for help from other students and the teacher, and student use of dictionaries. While this evidence strongly suggests that students were engaged in applying the strategy in a problem-solving manner, additional confirmation of this might be gained by obtaining continuous "think aloud" protocol evidence throughout the independent practice trials. This was not done in this study because of the classroom nature of the study and the time that it would have taken to collect such data. However, it would be interesting to investigate whether student use of overt self-talk (of the "think aloud" type) during independent practice would facilitate or inhibit performance of adolescents with learning disabilities on this strategy.

In summary, this study found that training in the word identification strategy reduced the number of oral reading errors made by all subjects. While reading comprehension increased for most students, increased reading comprehension at passing levels was not an automatic outcome of this intervention. The training in this study consisted of three major dimensions. First, the strategy intervention was conceptualized and taught as a problem-solving process rather than as a decoding process. Second, a specific and detailed set of instructional procedures was utilized to insure student understanding, memory, and mastery of the strategy. And third, the teachers who provided the intervention to students had completed a training program in the basic tenets of the learning strategy instructional approach and the word identification strategy. These elements, combined with the actual steps of the word identification strategy, resulted in an effective academic intervention for the adolescents with learning disabilities who participated in this study.

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NOTE

These procedures are described in detail in an instructor's manual for the strategy. Information about this manual can be obtained by contacting Dr. Frances L. Clark, 223 Carruth-O'Leary Hall, Institute for Research in Learning Disabilities, The University of Kansas, Lawrence, KS 66045.

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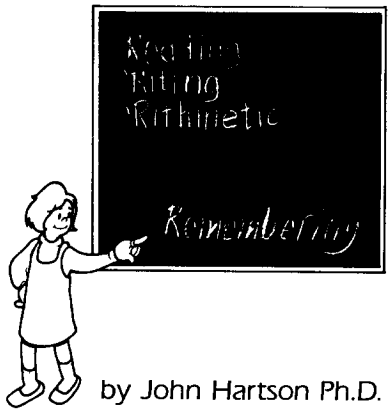

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