VOLUME 22 NUMBER 9 MAY 1990

FOCUS on EXCEPTIONAL children

Techniques for Mediating Content-Area Learning: Issues and Research

Edwin S. Ellis and B. Keith Lenz

Understanding and remembering associated concepts and facts presented in content-area classes (e.g., social studies, geography, health, history) and then applying and demonstrating mastery of these concepts and facts are the two core demands of secondary school settings. Many mildly handicapped and low achieving students often perform poorly in these areas because they (a) do not seem to employ effective strategies related to successful learning and performance (see Wong, 1985a, 1985b), (b) do not possess sufficient prerequisite subject-matter knowledge to learn readily by association (Wong, 1985b), and (c) must face instructional environments (e.g., teacher's instructional style, the manner in which a textbook is written) that often contribute to learning problems and do not facilitate mastery of the subject matter (Schumaker & Deshler, 1984). As a result, training students to employ various types of learning strategies that will promote more successful content-area learning has become an important instructional alternative for teachers of students with mild handicaps.

Teachers have quickly learned, however, that the power of both single and multiple strategies is often limited by a student's knowledge base. For example, a strategy to promote point-of-view writing is of limited value if, when attempting to state a position about the sources of racism in this country, students do not possess sufficient knowledge about racism. Also, a strategy for paraphrasing content in reading has limited value if the text contains extensive vocabulary and concepts that are unfamiliar to the student (e.g., metamorphosis in reptiles).

Clearly, an interdependence is present between the ability to employ effective learning strategies and the ability to retrieve important information from a knowledge base upon which the strategy is to be employed (Chi, 1981; Voss, 1982; Wong, 1985b). Unfortunately, because of the nature of many special education pull-out programs in elementary and secondary schools, many mildly handicapped students are denied opportunities to acquire content knowledge. Participation in resource room special education programs that focus on remediation of basic skills often has required students to miss content-area lessons (e.g., science, geography). As a result, opportunities to acquire important content-area knowledge frequently are reduced. (To paraphrase the prison guard in the movie *Cool Hand Luke*, "What we have here is a failure to accumulate.") Although strategy instruction holds great potential for many mildly handicapped and low-achieving students, simultaneous attention to direct instruction in content-area subjects continues to be a critical need.

Edwin Ellis is affiliated with the Department of Educational Psychology, University of South Carolina. Keith Lenz is affiliated with the Institute for Research in Learning Disabilities, University of Kansas.

Studies reviewed in this article were selected because each addressed topics directly related to teaching content-area information to low-achieving students or students with mild handicaps. Unless otherwise noted, the subjects identified as learning disabled were identified as having marked discrepancies (i.e., 15 or more standard score points) between intellectual ability and achievement. Each study employed either a true or a quasi-experimental design, and the efficacy of the techniques investigated was demonstrated by a minimum of .05 level of significance or, in the case of time-series designs in which statistical analysis was not appropriate, a replicated marked change in performance following stable baseline periods. The studies were selected for review here because they were representative of the empirical basis for the adaptive teaching procedure of concern; they are not intended to be inclusive of the entire body of research in this area.

FOCUS ON EXCEPTIONAL CHILDREN

ISSN 0015-511X

FOCUS ON EXCEPTIONAL CHILDREN (USPS 203-360) is published monthly except June, July, and August as a service to teachers, special educators, curriculum specialists, administrators, and those concerned with the special education of exceptional children. This publication is annotated and indexed by the ERIC Clearinghouse on Handicapped and Gifted Children for publication in the monthly *Current Index to Journals in Education* (CIJE) and the quarterly index, *Exceptional Children Education Resources* (ECER). It is also available in microfilm from Xerox University Microfilms, Ann Arbor, MI. Subscription rates: Individual, $27 per year; institutions, $36 per year. Printed in the United States of America. Second class postage is paid at Denver, Colorado. **POSTMASTER:** Send address changes to:

Love Publishing Company
Executive and Editorial Office
1777 South Bellaire Street
Denver, Colorado 80222
Telephone (303) 757-2579

Edward L. Meyen, University of Kansas
Glenn A. Vergason, Georgia State University
Richard J. Whelan, University of Kansas Medical Center
Stanley F. Love
Carolyn Acheson

MEDIATION OF CONTENT-AREA LEARNING

Mediation is the process involved in taking new (and sometimes difficult) information and translating it into a form that is meaningful and memorable. It also involves checking to assure that information is comprehended. Mediation occurs via the manner in which teachers and the tools they employ (e.g., textbooks, graphics, video documentaries, audio recordings) communicate subject-matter information and facilitate student interaction with the information in a manner that will promote student understanding and remembering.. This mediation process may include the specific adaptations, modifications, or instructional techniques the teacher uses, or the tools the teacher selects, to facilitate learning and performance. The assumption is that the teacher's careful use of mediators will induce the student to process information more effectively and efficiently through the selection and use of targeted external stimuli.

Of course, not all procedures a teacher employs will be equally powerful in influencing learning. The power of a teacher mediator likely will depend on the extent to which it promotes internally generated mediation by the student. That is, the most effective teaching methods and materials are those that will promote the student's active learning through the emphasis and use of instructional cues, routines, or devices that will promote understanding, remembering, and organization. As a result, the more limited is a student's ability to internally mediate learning through appropriate cognitive strategies, the greater the need will be for a teacher to promote successful learning and performance through the use of appropriate instructional cues, routines, and devices.

Although effective instruction has been the subject of considerable discussion with normal achievers (e.g., Brophy & Good, 1984; Joyce & Weil, 1980; Rosenshine, 1979), considerably less research has been generated examining the efficacy of these techniques as learning mediators for low-achieving students, and still less research has been conducted to examine the efficacy of these techniques for maximizing the acquisition of specific content-area knowledge. Even though the research on use of general techniques with this population remains vague, five clear instructional options related to promoting content-area learning have emerged from practice. These options provide an initial framework for discussing the relative merits and related research associated with these different approaches to content-area instruction. The five instructional alternatives are: (a) adjusting the curriculum so students

do not have to learn as much, (b) selecting textbooks that are conducive to learning, (c) enhancing content through the use of study guides, graphics, and mnemonics, (d) using audio recordings of text material, and computer-assisted instruction, and (e) promoting the use of appropriate cognitive and metacognitive strategies during direct instruction of content-area subject matter.

Content Reduction

Reducing the quantity or changing the emphasis of a curriculum represents an approach to teaching content-area information to low-achieving students that schools commonly follow (Wiederholt & McEntire, 1980). Curriculum, as used here, is narrowly defined as the set of objectives that define what will be learned and the materials used to articulate the content. Reducing the breadth of the curriculum to enhance the acquisition of appropriate secondary content can be a valuable strategy for teachers. Reducing the curriculum may relieve frustration and provide success for some individuals who have been unsuccessful in secondary content learning.

Although this approach is a common practice in schools (Deshler, Lowrey, & Alley, 1979; Schumaker & Deshler, 1984; Schumaker, Deshler, & Ellis, 1986), a review of the research literature suggests that evaluation of this practice has been practically nonexistent. In the absence of research in this area, educators appear to rely on speculation and personal perspectives with regard to its efficacy.

It is also important to decide what types of curriculum modifications are ethically appropriate. For example, if the goal of a course is for students to attain 20 objectives, and a course adjustment is made that allows a learner to gain only one objective, the student will likely attain that objective. But, unfortunately, this strategy does not maximize the student's potential for learning. As a result, both learner and knowledge and "opportunity to learn" are lost. Therefore, if curriculum content is reduced, the amount or kind of information that can be acquired is limited even before learning can begin, regardless of the quality of teaching. The instructional question is whether this practice is implemented to appropriately meet the learning needs of students or whether it is implemented to meet the functional needs of teachers.

Regardless of the intent of this practice, some evidence suggests that reduced curriculum expectations may negatively affect the potential for future learning. For example, many adolescents with learning disabilities appear to be further handicapped by their limited background information in certain content areas. Lenz and Alley (1983) found that adolescents with learning disabilities had significantly less background knowledge of social studies content than their normally achieving peers, yet both groups were required to meet the same content classroom demands. This lack of background knowledge might be explained as the result of either an inability to learn the information or the absence of the "opportunity to learn" the information.

The cumulative effects of insufficient opportunity to learn could reduce the potential meaningfulness of information important for continued learning. As a result, the efficacy of reducing the quantity of material to be learned has not been researched adequately, and the practice of reducing the amount of content the low-achieving student must learn may actually limit opportunities to acquire knowledge.

Learnable Text

The problem of insufficient "opportunity to learn" can be illustrated by school district attempts to offer basic or modified curriculum courses. These courses often introduce controlled textbooks and materials as the primary means of curricular adjustment. Specifically, a school district or teacher selects an alternate text to the one used in the regular course. These textbooks and materials often feature a controlled reading level, shorter chapters, and an increased number of visual aids. Some research indicates, however, that these texts may not facilitate student learning.

For example, the methods used to control the readability levels of textbooks yield a number of problems. Popular readability formulas, which often guide the development of controlled texts, tend to emphasize word length, sentence length, word familiarity, and sentence complexity (Dupuis & Askov, 1982). Lovitt, Horton, and Bergerud (1987) noted that different readability formulas do not produce similar scores on the same text and a student's reading achievement scores on different standardized tests are typically inconsistent. Moreover, two texts can obtain the same readability scores but be markedly different in their comprehensibility because of the nature of their organization, use of visual aids, sentence structure, and so forth. In fact, if texts are modified based on the application of reading formulas, the elements that indicate important relationships may be eliminated in the process of achieving formula compatibility. The readability of a textbooks may involve considerably more than what readability formulas measure.

Anderson, Armbruster, and Kantor (1980) suggested that the readability of text should be based on structural coherence, unity, and audience appropriateness. These elements

serve to cue the learner as to the various relationships between ideas in the text and those of the learner. The question of contextual relationship also emerges when larger topics or chapters are subdivided into shorter chapters. Whether these types of chapter configurations facilitate or inhibit content acquisition is unclear.

Another feature often included in controlled textbooks is the increased use of visuals (the increase may be in number or size, or both). This practice has been challenged by some researchers who have found that illustrations make text more difficult for some naive readers (Harber, 1983). Lenz, Alley, Beals, Schumaker, and Deshler (1981) found that visuals (pictures, graphs, charts, maps) used in controlled textbooks were harder for adolescents with learning disabilities to interpret for meaning than were visuals found in grade-level textbooks. Learning disabled adolescents were able to generate more statements relevant to the surrounding text from the visuals in grade-level texts than from those in controlled texts. An analysis of the visuals in the two types of texts indicated that the visuals in the controlled textbooks tended to be used for motivational or decorative purposes rather than to inform. The visuals also tended to supplant text rather than complement text, thus forcing students to make their own contextual generalizations. This finding is in contrast to research findings indicating that visuals are most helpful to readers when they are tied directly to the text in specific ways (Schallert, 1980).

Because textbooks play a major role in delivering content-area information to students, selection of texts should be based on the extent to which the book incorporates features that provide prompts and cues similar to those a teacher provides when mediating learning. Adjunct questions, objectives, advance organizers, summaries, pointer words, and textual highlighting are examples of textual mediators that have been found to be effective for poor comprehenders (Meyer, 1981). In an analysis of elementary- and intermediate-level textbooks, Armbruster and Anderson (1988) reported that most textbooks were deficient in structure (the manner in which ideas and relationships are organized in the text), coherence (the logical flow of ideas presented in text), and audience appropriateness (the match between the text and the reader's level of knowledge and skills).

Common problems with text structure tended to center on the texts' failure to employ organizational signals (e.g., introductory statements, pointer words such as "first," "second," "third," and textual cues such as boldface print words). In addition, the structure employed in the textbooks was often illogical. Rather than having a book with structures that mediated students' selection of critical information and facilitated its organization into a coherent concept, students' books often presented information that required the readers to "simply encode information as an unstructured list of ideas" (Armbruster & Anderson, 1988, p. 48).

With regard to coherence, Armbruster and Anderson (1988) reported that textbooks often presented information in a "list-like format which failed to convey the relationship inherent in the text" (p. 49). Transitions between topics were often sudden, and sequences presented in the text frequently were out of chronological order or occurrence in real time. Linguistic cohesive ties that help carry the meaning across phrases, clauses, and sentences tended to be a major shortcoming. To produce lower readability scores on textbooks, publishers seemed to shorten sentences by transforming compound and complex sentences into simple independent clauses by removing coordinating and subordinating conjunctions that served as cohesive ties. The result was that the material was more incomprehensible.

With regard to audience appropriateness, Armbruster and Anderson (1988) noted that many textbooks failed to account for the readers' limited amount of knowledge about the topic addressed by the text. Texts would "mention topics superficially" (p. 50) rather than provide sufficient explanation. Texts also tended to use words or phrases that failed to define important terms and used terms that were too vague to be of much use (e.g., "the *stuff* cells are made of . . .").

Armbruster and Anderson (1988) recommended carefully screening textbooks so that the textbooks most "considerate" to the reader are selected for use. They recommended texts that (a) were not characterized by the above limitations and (b) employed ample cues that would facilitate learning. The selection of "considerate" textbooks does not necessarily mean that students will capitalize upon these learning mediators, though. Schumaker, Deshler, Alley, Warner, and Denton (1982) found that students with learning disabilities did not necessarily use textbooks comprehension enhancing cues when reading. Students with learning disabilities tended to ignore cues such as titles, headings, and subheadings; boldfaced words; study questions; main idea statements; introductions; and summaries. But Schumaker et al. demonstrated that the effects of these types of textual variables could be maximized when adolescents with learning disabilities were taught how to identify and use them to facilitate textual learning. Therefore, curricular mediation appears to operate under the same condi-

tions as teacher mediation in terms of learner awareness. Careful text selection may have to be accompanied by teaching students how to use cues effectively.

To summarize, selecting alternative textbooks thought to be controlled for reading difficulty is problematic because the quantity of material to be learned is reduced and the presentation of the content in controlled textbooks may actually inhibit, rather than enhance, the "learnability" of subject matter. A more desirable way to accommodate low achievers in content classes might be to make the subject matter more learnable by employing instructional procedures and materials that mediate learning experiences. Moreover, textbooks sometimes are inconsiderate to the learner because of limitations associated with structure, coherence, and audience appropriateness. Low-achieving students do not necessarily capitalize on learning cues when they are present but many of these students can be taught to look for and use these cues. Because up to 44% of the information for which students are responsible in learning is presented in textbooks (Zigmond, Levin, & Laurie, 1985) and because many textbooks appear to be inconsiderate (Armbruster & Anderson, 1988), teachers often have to provide additional instruction as an adjunct to the text to successfully mediate learning.

Enhancing Content

Study Guides

One of the ways teachers can cue the organization of information is by using structured study guides consisting of sets of statements or questions designed to accompany reading assignments or teacher's lectures. Three common types are (a) multi-level guides, (b) concept guides, and (c) pattern guides (Horton & Lovitt, 1987). Multi-level guides are designed to address literal, interpretive, and applied levels of comprehension, whereas concept guides are designed to make new information more memorable by facilitating conceptual links or associations between the new information and that previously learned. Pattern guides are designed to enable the learner to recognize patterns of information (e.g., enumeration, sequence, compare/contrast, cause/effect).

Study guides can be employed in many ways. Two common approaches are either to (a) give the student the study guide to use as he or she independently reads an assignment or to (b) use a teacher-directed approach in which the student first reads the passage and then is provided the study guide; the teacher directs a discussion of the questions from the study guide while working with an overhead projector. This discussion typically is followed by a short test on the content-area information. Thus, the student's use of the study guide is mediated by the teacher.

To determine the relative effectiveness of multi-level study guides under teacher-mediated conditions relative to self-study conditions, Horton & Lovitt (1987) developed multi-level study guides to accompany two chapters from textbooks for science and social studies middle school and high school classes. Further, the researchers developed tests containing 15 multiple-choice questions to accompany the chapters. Results of the study indicated that almost half the students in the self-study condition scored below minimal mastery levels (80%) in the self-study condition. But when these same students were exposed to the teacher-mediated study guide condition, at least 90% of them improved. More notable, with the teacher-mediated study guide condition 60% not only improved but also scored at or above the minimal mastery levels.

The researchers conducted a similar study to examine the relative effects of student-directed study guides in which the student is provided the study guide but the teacher does not mediate the learning process by conducting a discussion of the study guide questions. In this study, the students independently completed the study guides at their desks, participated in a 5-minute feedback session to check their accuracy, followed by a 5-minute study session, and then took a 15-item test. Results indicated that about half the students scored below the minimal mastery level following the self-study condition. In the student-directed study guide condition, 63% to 74% of these same students scored above the minimal mastery levels.

Unfortunately, the small number of students classified as learning disabled precluded a separate analysis of their performances, but the researchers did report that 13 of 16 of the students with learning disabilities improved with study guides, but only seven of these improved to levels at or above minimal mastery levels. Thus, the study guides helped considerably but were insufficient, in and of themselves, to facilitate mastery of the material. A possible explanation is that although the teacher may facilitate the learning process by providing organizational cues in the form of study guides and teacher-directed use of the guides, the learning process may continue to be impaired because of memory deficits or lack of cognitive learning strategies commonly attributed to students with learning disabilities.

In light of the considerable evidence suggesting that low

achievers benefit from high levels of teacher-mediated instruction, they likely will benefit more from teacher-directed study guides than from student-directed approaches, but this remains an untested observation. Clearly, however, use of study guides is preferable to self-study conditions.

Use of Concept Maps and Graphic Organizers

Another important technique teachers can employ to mediate the learning experiences of their students with learning disabilities is to supplement textbook materials with graphics (e.g., charts, diagrams) that provide visual displays of the subject matter's organization or structure. The "organizational function of pictures" (Levin, 1981a) has been used in various ways, including "semantic maps" (Johnson & Pearson, 1978), "networks" (Dansereau & Holley, 1982), and what Scruggs et al (1985) referred to as "figural taxonomies," or graphics that display superordinate, coordinate, and subordinate relationships between concepts, facts, and details, or some combination thereof. Graphic representations can assist in making the material more learnable because students with learning disabilities often lack the basic reading skills to extract the information from texts (Torgesen & Licht, 1983) and the texts themselves are often "inconsiderate" because of poor structure and organization (Anderson & Armbruster, 1984).

Several studies have demonstrated that learners (with poor reading ability, low verbal ability, and underdeveloped vocabulary) performed better when graphics were used to supplement regular content area text chapters (Koran & Koran, 1980; Moyer, Sowder, Threadgill-Sowder, & Moyer, 1984). Recent studies have provided positive evidence that the use of graphics as supplements to textbook material can be more effective than individual study conditions when used with students with learning disabilities. Darch and Carnine (1986) demonstrated that upper-elementary students (grades 4, 5, and 6) with learning disabilities benefited from visual displays when they were mediated by the teacher. Here, the teacher used an overhead projector to present a display containing labeled cells. Students were taught using a teaching script describing the cells and their interrelationships. Later, the teacher mediated the information by guiding students through the information using a visual display in which the cells were not labeled. These students performed significantly better when compared to others in a self-study condition wherein the content was presented only by text and discussed by the teacher. The visual display group scored an average of 86% correct on probes, whereas the test group scored an average of only 56%. But the study also revealed that the students in the graphics condition did not readily self-mediate use of visual displays when presented with new text information; they remained dependent on the teacher to mediate use of the graphics.

In a related study, Bergerud, Lovitt, and Horton (1987) investigated the effectiveness of using graphics, as compared to study guides or self-study conditions, with high school students who were learning disabled. The students attended either a 9th grade basic science class or one of three other study skills classes (grades 9-12) for students with learning disabilities. Each class was exposed to each of the three treatments. Passages were taken from a life sciences textbook, and 20-item multiple-choice tests were constructed for each passage. Graphics and study guides to be used in conjunction with the texts also were constructed.

Results of the study indicated that the graphics treatment was the most effective in helping students attain the highest scores (60.5% of the students had scores above the minimal mastery level of 80% on the tests when graphics were used to facilitate the organization of the material). In the study guide condition, 42.1% of the students attained minimal mastery level. When students were placed in the self-study condition, only 31.6% achieved mastery. Although the use of graphics proved to be the most effective in helping the greatest number of students, using either graphics or study guides was better than or equal to 98% of the students in the self-study condition.

Technological Alternatives to Textbooks

To supplement and even to supplant textbooks, many educators have resorted to various machines and media devices (e.g., tape recordings, films, television programs, microcomputers, laser disks for delivering content or modifying the content to be learned. Advances in technology over the past 10 years and the increased availability of technological products to schools have made these options popular, although not necessarily effective. The broad body of research on effective teaching methods for learning disabilities reviewed above indicates that many low-achieving students may not possess skills for internal mediation (i.e., metacognition) to be able to capitalize upon known learning strategies. Many students who are considered mildly handicapped in their ability to learn can effectively perform various learning strategies when cued to do so by others, but they often fail to employ the strategies when left to themselves. Some recent work has focused on using machines as

supplements to the teacher's direct instruction, with promising results. The machines are used as mechanisms for providing students with cues to use various learning strategies.

Audio Recordings of Text

The audio recording method relies heavily on transferring knowledge to audio tapes and then playing the tapes for the student. Textbooks and lectures are audio recorded to circumvent a reading problem or to allow for repeated listenings that facilitate notetaking and comprehension of information. Although research on the effectiveness of audio recording textbook material with adolescents who have learning disabilities is sparse, the research in this area can be divided into three groups: (a) verbatim recordings, (b) variable-speed recordings, and (c) recordings combined with strategy instruction and active student responses.

Verbatim audio recording is a common method used to accommodate the reading problems of low-achieving students, but research has led to mixed results with regard to its effectiveness with adolescents who have learning disabilities. For example, Mosby (1979) reported that the use of verbatim tapes of social studies material resulted in increased year-end achievement test scores for students classified as "high-audio" students over those classified as "low-audio" students; however, significant improvement in students' social studies grades was not demonstrated across the group. Wisemen, Hartwell, and Hannafin (1980) also found that although listening facilitated content acquisition for some students, the listening condition actually caused poorer performance for some high- as well as low-functioning readers. Torgesen (1984) reported that verbatim tapes acquired through the American Printing House for the Blind produced significant gains in comprehension in an experimental group of adolescents with learning disabilities when compared to a control group of adolescents with learning disabilities. Unfortunately, the effects were not consistent for all experimental group subjects in the study. Torgesen suggested that verbatim tapes appeared to be most beneficial for adolescents with learning disabilities who demonstrated poor decoding skills in conjunction with relatively higher intellectual abilities.

Some researchers have investigated the effect of presenting content at *variable rates* (words per minute) to students with learning disabilities (D'Alonzo & Zucker, 1982; Sawyer & Kosoff, 1981). In these studies, tape recorders capable of presenting the content at expanded, normal, or compressed rates were used to present content to adolescents with learning disabilities. Findings from these studies suggest that presentation rate generally does not affect comprehension of content information. Factors similar to those associated with reading comprehension skills (e.g., students' prior knowledge of related content, vocabulary diversity) more likely account for learning variance. Because comprehension does not seem to be affected by rate of presentation, however, the use of time-compressed recordings (i.e., more content covered in a shorter time) may be more desirable because they are more efficient.

Rationales for using audio-tape formats are sometimes based on an "aptitude-treatment interaction" (Lloyd, 1984). A common application of this interaction is to design instruction around the perceived modality strengths of the student ("auditory" versus "visual" learners). Thus, students who are presumed to be auditory learners are provided with audio formats (Mosby, 1980). The effectiveness of this form of intervention has yet to be demonstrated. For example, Miller (1983) found that the performance of adolescents with learning disabilities on minimal competency tests did not differ significantly when the test was read to them versus when they had to read it without assistance. This compensatory (Deshler, Schumaker, Lenz & Ellis, 1984) approach is based on the assumption that students' modalities can be reliably and validly assessed, and that the treatment has both internal and external validity, but these assumptions have not been empirically supported (see Lloyd, 1984, for a review).

In addition, the model itself may be an over-simplification of the learning process and problems manifested in learning disabilities. Specific modality-based interventions often fail to incorporate well established principles of learning and motivation (e.g., opportunities for active involvement in the learning process). Verbatim audio-tape formats often suffer from these limitations as well as from a lack of time and training for teachers who would be responsible for producing the audio recordings (Schumaker, Denton, & Deshler, 1984). More important, verbatim recordings provide minimal cues for facilitating internal mediating processes. They do not facilitate or teach students to use various learning strategies that might be necessary to acquire and remember content-area information. If the student fails to employ basic cognitive and metacognitive strategies while listening to the recordings, minimal learning is likely to occur.

In response to these problems, Schumaker et al. (1984) developed a skill-assisted audio tape recording package that included procedures for audio taping content material and

teaching adolescents with learning disabilities how to gain information from the audio-taped materials through the use of three specific strategies. The first strategy was designed to facilitate students' use of critical behaviors associated with previewing information to be learned from the tape and textbook. The second strategy was designed to facilitate application of various cognitive strategies (e.g., self-questioning, paraphrasing) for elaborating on information presented by the tape and textbook. The third strategy was designed to facilitate students' application of a rehearsal process for learning the material and the use of metacognitive strategies associated with monitoring whether what needed to be learned had been learned.

The audio-tape format varied so that cues to use the various cognitive strategies noted above were embedded on the recording. History textbook chapters were visually coded with a special marking system that appeared in the text margins. One code indicated a verbatim reading of a particular section; another code indicated that the section was paraphrased on the tape; a third code indicated that it was being skipped altogether; and so on. The students listened to the audio recording while following the visual codes noted in the textbook. Schumaker et al. (1984) reported that performance, as indicated by regularly administered classroom tests, was significantly better following training in the three strategies in conjunction with the specially recorded audio tapes as opposed to when they listened to verbatim tapes; moreover, they performed superior to a control group of students who listened to verbatim tapes. This gain was demonstrated over textual information that exceeded the reading ability of the students by as much as 7 years.

In summary, providing students with an alternative to traditional instructional delivery methods does not necessarily translate into the student's improved content learning. Results from research on audio taping content material indicate that some students can learn content from audio tapes, especially when the audio presentation contains cues to mediate learning processes in conjunction with student training regarding how to use these mediators.

Computerized Study Guides

Within content classrooms, computer-assisted instruction (CAI) can be used as an external mediator for teaching new knowledge and skills. Although much of the current software is inappropriate or only marginally helpful in acquiring new skills or knowledge (Carlson & Silverman, 1986) and few studies have investigated the role of microcomputers when used as a mediator of new skills or content (Ellis & Sabornie, 1986), the limited evidence suggests that the microcomputer may be effective when used to directly teach content and skills as a technological adjunct to textbooks in the form of computerized study guides.

Printed study guides containing questions and statements adjunct to textbook material (e.g., Anderson & Biddle, 1975; Herber, 1970; Riley, 1979; Reder, 1985) have been used with considerable success to assist students with learning disabilities in a variety of content-area information (Horton & Lovitt, 1987; Lovitt, Rudsit, Jenkins, Pious, & Benedetti, 1985). In a recent study Horton, Lovitt, and Givens (1989) demonstrated that CAI could be designed to incorporate the advantages of printed study guides and, in addition, present new material, provide opportunities for practice, and test students' knowledge of the information.

The CAI consisted of three segments: (a) an approximately 1,000-word passage taken verbatim from a history textbook; (b) a set of 15 short-answer questions based on main ideas from the reading passage; and (c) a multiple-choice test containing 15 questions. Students using the CAI were allowed 15 minutes to read the passage and then were required to silently answer the study questions twice during another 15-minute period, and finally were required to complete the test within a 10-minute period. When the CAI group was compared to a control group of students who were told to take notes and study the same passages, the CAI group performed significantly higher on the tests. Although the study demonstrated some promising results with regard to technological alternatives to textbooks, generalizability of the results is somewhat limited for the general low-achieving population because the subjects had an average silent reading rate of 140 words per minute. Another limitation of the study was that it did not compare the CAI study guide with a printed study guide, nor did the study compare groups of students using the CAI with groups that had mastered a specific notetaking strategy.

Promoting the Use of Appropriate Learning Strategies During Direct Instruction in Content-Area Information

A considerable amount of research has demonstrated the efficacy of using a systematic lesson structure as well as a set of key instructional behaviors that have come to be collectively called *direct instruction*. This form of instruction has demonstrated effectiveness with remedial learners (e.g., Becker, Engelmann, Carnine, & Maggs, 1982; Carnine & Silbert, 1979; Gersten, 1983). Direct instruction uses a variety of techniques to increase the number of student responses, including questioning students to elicit individu-

al oral responses, *cueing* students to provide group unison responses, and cueing students to make individual or unison motor responses (e.g., "Everybody, look at your maps; put your pencil on the spot on your map that shows where the Boston Tea Party took place"). A key purpose of eliciting frequent responses from students is to maintain high levels of student attention on the subject matter.

With the direct instruction model brief acknowledgments of correct responses, tangible reinforcers (e.g., tokens or points that are redeemable), and positive and corrective feedback are employed frequently as *reinforcement*. The primary purpose is to reinforce student efforts at learning and to provide critical information with regard to correctness of the learning. These first two features (cueing for responding and reinforcement) can be conceptualized as the manner in which the teacher structures the climate to maximize learning of content-area information. The last feature, *repetition*, is characteristic of direct instruction because the model frequently requires learners to repeatedly recite information to be learned. Unfortunately, *less sophisticated* direct-instruction teachers encourage students to use repetition, or rote rehearsal, as the primary learning strategy (Scruggs et al., 1985). It is quite possible to elicit frequent responses from students while simultaneously cueing them to use more sophisticated learning strategies.

This brief analysis of the direct instruction model shows that the primary function of the content teacher is to structure the learning climate and to mediate students' use of learning strategies as content information is being taught. Our primary concern in this article is not with the manner in which teachers use techniques to manipulate the learning climate but, rather, to analyze what they can do to mediate students' use of optimal learning strategies for efficient learning and retention of the content-area information, and to identify what teachers can do to make information more learnable.

Three elaborative strategies that teachers can mediate are *paraphrasing, visual imagining,* and *questioning*. These strategies are elaborative in the sense that they require the student to elaborate on the content by transforming information to be learned into their own language structures, to construct images that depict the meaning of the material that is to be remembered (Pressley, 1977; Pressley, Johnson, & Symons, 1987), and to activate prior knowledge by posing questions about information to be learned. Ample evidence suggests that students can benefit from instruction in the use of these strategies (see Pressley, 1977, and Wong, 1985b, for reviews). The emphasis in this research has been on teaching students the strategies and then measuring how well students apply the strategies to master content-area information. Less research involving students with mild learning handicaps has investigated how these strategies can be incorporated into instructional routines (e.g., direct instruction models) in which (a) the emphasis is on mastering the content, not mastering the strategic skill, and (b) the more efficient strategies (e.g., paraphrasing) are substituted for less efficient ones (e.g., rote repetition).

Pressley, Johnson, and Symons (1987) noted that material often has to be restructured into a form that is "more learnable." This more learnable material is presented in such a way that (a) mnemonic elaboration is facilitated, (b) it is rich with structures, cues, and devices that facilitate learning, or both. Facilitating mnemonic elaboration of material involves processes that allow separate bits of information to be learned and remembered as units or as a whole. As discussed earlier, the use of specific structures, cues, and devices must direct the learners' attention to the critical information, should guide the student in how the information should be processed, and should be explicit or easily recognized by the learner. Combining the two approaches can be a particularly potent way to facilitate content learning. To illustrate pragmatic applications of these techniques, two forms of mnemonic elaboration are discussed below.

Mnemonics

Two mnenomic strategies that serve as elaborative techniques are the "key word" and the "peg word" methods. These are particularly useful for facilitating students' learning of vocabulary terms and lists commonly found in science, social studies, history, and health curricula (Atkinson & Raugh, 1975; Levin, 1981a, 1981b, 1983). The key word method involves teaching students to pair new vocabulary words with previously learned concrete words that phonetically sound like or look like the new word. Saying the new word cues the sound-alike familiar word, and then the association with the familiar word cues recall of critical features of the definition.

Peg words are used to recall an ordered list of words (e.g., the order of states that seceded from the union during the Civil War). Students are taught a group of rhyming words for the numbers 1–10 (e.g., one–bun, two–shoe, three–knee, etc). The ordered rhyming words are paired with the previously learned key words to recall a specific list of items in the correct order. Use of graphics in combination with teacher-mediated mnemonic instruction appears

to be a promising way to increase mastery of science material by students with learning disabilities (Mastropieri, Scruggs, McLoone, & Levin, 1985; Scruggs et al, 1985). Combining graphics with key word and peg word mnemonic instruction allows the visual display to serve the organizational needs of learning, and the mnemonic features (use of key word and peg word mnemonics) of the graphic serve what Levin (1981a) termed the "transformational" function by facilitating the transformation of new, difficult information into a form that is easier to remember.

To facilitate learning of lists depicting four categories of information (mineral's name, color, function, and hardness rating), Scruggs first used key word mnemonics to facilitate knowledge of the first three categories of information for each mineral, and then used peg word mnemonics to facilitate knowledge of their order in terms of hardness ratings. Adding the dimension of graphic displays to further facilitate learning, the mnemonic information then was transferred into pictorial form. the mineral used in making cosmetics, calcite, with a hardness rating of "3", would be graphically illustrated by a picture of a cow putting gray cosmetics on her knee (to coincide with peg words for 3–"knee"). Mastropieri and her colleagues demonstrated that using mnemonic key words and peg words, in conjunction with graphic displays of the mnemonic features of the lists, proved superior to teacher-directed instruction and free study of a list of basic minerals, their color, hardness scale, and functional use.

In a related study Scruggs et al. (1985) compared the use of mnemonic-graphics as a means of facilitating the learning of science information using figural taxonomy cellular graphic displays paired with direct instruction and free study conditions. The 36 junior high students with learning disabilities were randomly assigned to one of the three conditions and then tested to determine the extent of mastery of the material. Scruggs et al. found that the graphic displays with accompanying teacher-directed instruction were not significantly more powerful than free study conditions—a finding different from those reported by Horton and Lovitt (1987). Students in the mnemonic graphic condition learned almost twice as much information as did students from either of the other two conditions.

Prompting Strategic Interaction with Content Subject-Matter

When teaching content-area information, teachers can promote strategic learning by prompting students to employ various cognitive processes while interacting with the subject-matter. These processes include paraphrasing, summarizing, identifying main ideas and important details, predicting, generating questions, imagining, and relating new information to personal experiences and interests. These strategies can be prompted during verbal presentations of material presented in class using the "instructional pause procedure" (Rowe, 1976, 1980, 1983).

To use the procedure, the teacher provides direct instruction on the content subject-matter for approximately 8 minutes and then initiates an activity that requires students to use various cognitive learning strategies (e.g., "Talk among the other members in your group and decide what was the main idea and two of the most important details of what I just taught" or, "Talk among the other members in your group and make a prediction about what will happen when I add sulfur to this mixture. Then we'll see if your prediction is correct" or, "Decide what would be a good way to remember. . . ."). The teacher then allows the students about 2 minutes to formulate their response and picks one group to express its response to the entire class. The other groups compare their response to the one expressed to class. By frequently utilizing the instructional pause technique to prompt strategic interaction with the material to be learned, students employ general elaboration strategies (e.g., paraphrasing) as they discuss the topic among themselves, as well as the specific strategy cued by the teacher (e.g., main idea generation, predicting), and they employ monitoring strategies when they compare their responses to those of other groups.

The empirical validity of the pause procedure in a classroom situation is promising, but only a few studies have investigated this option as applied to mildly handicapped or low-achieving students in secondary school settings (e.g., Hawkins, 1988; Hudson, 1987; Hughes, Hendrickson, & Hudson, 1986). Hawkins (1988) investigated the effects of using the instructional pause technique on the mastery of verb-identification skills by eight 7th and 8th grade students with severe behavior disorders. A multiple-baseline across student dyads designed was used. Results of the study showed moderate increases in verb-identification skills in seven of the students and a statistically significant response generalization as indicated by correct use of these verbs when writing. Hawkins noted that the procedure was particularly appropriate for students with short attention spans, low frustration tolerance, and limited impulse control.

Providing a Metacognitive Orientation to Learning Content Subject-matter

A technique that has received relatively little research attention involves having the teacher model metacognitive processes during content-area instruction and prompting

students to use it when learning (Ellis & Sabornie, 1989). When teaching, metacognition can be modeled by making covert thoughts overt, or by thinking outloud to illustrate for students the thought processes associated with analyzing what is to be learned and what is the best way to go about learning it. To prompt students use of metacognition, the teacher can provide students with a listing of information to be learned, and then work with students to prioritize the information, organize it, and decide the best way to learn it, decide which parts will be most difficult and easy to learn, and predict how much study time different parts of the material will require. Here, the content teacher acts both as an information source for the subject-matter and as a collaborator in the learning process.

The application of cognitive learning strategies also can be modeled by the teacher using a form of didactic, or reciprocal teaching, instruction (e.g., Palincsar & Brown, 194). Here, the teacher provides a lecture about the content-area information while modeling the use of predicting, question generating, summarizing, and clarifying strategies. The teacher then prompts students to perform these strategies. Critical to this process is not just modeling and prompting students to use various strategies but also discussing with students why they are using them, when to use them, and how effective they seem to be working. The process is not limited to teaching students simply to use the strategies but also to reflect more on the demands of a given task, how to address these demands, and how to monitor the effectiveness of the chosen strategy for meeting these demands.

To date, little empirical research has been generated demonstrating the effectiveness of providing a metacognitive orientation to learning content in classroom situations. The procedures currently employed are commonly adapted from various instructional models that have a discovery learning (e.g., Ausubel, 1961), didactic (Palincsar & Brown, 1984) and repeated modeling of strategies (Rosenthal & Zimmerman, 1978) orientation. These procedures are often further enhanced by providing students with a direct explanation (Roehler & Duffy, 1984) about why, when and where to use metacognitive thought processes and various learning strategies.

Cueing Students to Use Previously Mastered Specific Strategies in Remedial Settings

Instruction in the use of task-specific learning strategies is becoming an increasingly more common form of intervention in secondary special education programs (Deshler & Lenz, in press). These task-specific strategies focus on how to perform specific routine tasks commonly found in content-area classes (e.g., reading textbooks, preparing for and taking tests, writing themes or essays, test taking). For example, because many content-area classes require students to answer essay questions or write reports, resource room students might learn the "DEFENDS" strategy (Ellis, Courtney, & Church, in press) for writing point-of-view paragraphs.

When students learn task-specific strategies in special education settings, the primary role of the mainstream content-area teacher is to cue students to use these strategies to complete tasks. This can be accomplished via verbal cues (e.g., "This is a good time to use the DEFENDS strategy" and by integrating cues to perform the strategies in the course media. For example, explicit overt cues to use the DEFENDS writing strategy can be incorporated into study guide and test questions (e.g., "Use the DEFENDS strategy to state why you think the south lost the Civil War"). Several studies have demonstrated that when students have been taught task-specific strategies in remedial settings, providing cues to employ them in the targeted setting can have a dramatic effect on their use of the strategy and performance in the mainstream classrooms (for a review, see Ellis, Lenz, & Sabornie, 1987a, 1987b).

IMPLEMENTATION ISSUES

For various adaptive teaching procedures to have a positive and sustained impact on the lives of students with mild handicaps, the intervention must have empirical validity, teachers implementing the intervention must be sufficiently trained in its critical features, and the climate in which the intervention is to occur must be conducive to implementation. Teachers' perceptions of (a) competence in using the technique, (b) its value relative to attaining instructional goals, and (c) ease in which the intervention is employed are critical variables that influence this climate and will logically have a significant impact on whether teachers actually employ the procedure in their content-area classrooms.

Ellis and Sabornie (1989) investigated these variables in relation to six adaptive teaching procedures oriented toward facilitating the use of cognitive learning strategies in content-area classrooms. The differences of 13 content-area teachers' perceptions of familiarity, value, use, assistance needed to routinely implement, and reasonableness of being expected to routinely implement six cognitive strategy-based adaptive teaching procedures for facilitating mastery

of content-area information were investigated. The teachers were systematically trained in each adaptive teaching procedure and were asked to implement each procedure in their content-area classrooms. Following implementation, the subjects were queried using a forced-choice Likert instrument and a structured interview format.

The six adaptive teaching procedures investigated were the strategic enhancement of content-area information through (a) using organizational devices, (b) using mnemonic devices, (c) promoting strategic interaction with content subject-matter, (d) providing a metacognitive orientation to learning content subject-matter, (e) cueing students to use task-specific learning strategies mastered by students in remedial settings, and (f) integrating instruction in task-specific learning strategies with content-area instruction. Results of the social validity study indicated that teachers who had been systematically trained and were relatively confident in employing the adaptive teaching procedures in their classroom situations generally placed a high value on all six procedures and reported routine use of them. With regard to ease of implementation, the teachers reported that outside help would be beneficial but was not crucial to successfully implementing each of the six options, and that content-area teachers should be expected to routinely employ these procedures as part of their repertoire of instructional tools.

Qualitative data indicated that the teachers were significantly more confident with the more concrete procedures (e.g., enhancing content-area information through organizational devices and mnemonic devices) than with those that placed greater demands on their ability to communicate information-processing skills to others (i.e., providing a metacognitive orientation to learning content subject-matter). The metacognitive instructional orientation, however, received significantly higher ratings of value over the mnemonic forms of instruction. Teachers perceived the use of first-letter, key-word, and peg-word mnemonic devices as having relatively short-term benefits that were not likely to produce a sustained impact on students' knowledge base. Although teachers placed high value on the use of mnemonic devices when the information to be learned was limited in quantity, this form of adaptive teaching was valued less when extensive amounts of content information were to be learned (i.e., several different vocabulary terms, several different groups of items to be mastered for a single test).

As previously noted, although teachers viewed positively the use of adaptive teaching procedures, some teachers also indicated that they perceived teacher-directed instruction as somewhat incompatible with modeling metacognition and cognitive strategies. They also indicated perceived pressure from school district officials to "finish the book" and were reluctant to take the extra time they believed was necessary to adequately address the thinking domain associated with learning content-area information.

Ellis and Sabornie (1989) reported that the qualitative data reflected two overriding concerns. First, teachers expressed considerable concern about the time required to prepare lessons incorporating these adaptive teaching procedures, particularly when they would require critically analyzing the curriculum to prepare organizational and mnemonic devices. Comments were particularly critical of textbook publishers. Teachers believed commercial publishers should have the responsibility to supply them with preconstructed concept maps, figural taxonomies, and mnemonic devices, as well as to write texts rich with cues to employ cognitive reading strategies. Teachers also were concerned about how to make instruction simultaneously appropriate for low-achieving and high-achieving students enrolled in the same class. Teachers indicated that they believed the adaptive teaching procedures would be beneficial to all students, but they also expressed a concern that many normal and higher achieving students would quickly become bored with the instruction and that their learning might be compromised as a result.

Clearly, some adaptive teaching techniques may be more powerful than others in facilitating the mastery of content-area information, but little research has been conducted examining the relative power of various techniques. From a teacher's perspective, some fundamental questions must be addressed by future research: Which of the various techniques are the most powerful while requiring the least amount of energy to use? Which can be implemented on an individual basis without preparing special materials prior to delivering the content? Which of these adaptive teaching techniques can be readily integrated into traditional approaches to teaching content, and which require radical change?

THE CONTENT ENHANCEMENT MODEL

To address some of these concerns, a model for promoting successful content learning through the careful selection, organization, and delivery of information is being developed currently by researchers at the University of Kansas Institute for Research in Learning Disabilities (Bulgren, Schumaker, & Deshler, 1988; Deshler & Schumaker,

1988; Lenz, Alley, & Schumaker, 1987; Lenz & Bulgren, in press; Lenz, Bulgren, & Hudson, in press; Lenz & Mellard, 1990; Schumaker, Deshler, & McKnight, in press). The model being developed by these researchers is called the Content Enhancement Model. Lenz, Bulgren, and Hudson (in press) define content enhancement as the process of teaching scientific or cultural knowledge to a heterogeneous group of students in which: (a) group and individual learning needs both are met; (b) integrity of the content is maintained; (c) critical features of the content are selected, organized, manipulated, and complemented in a manner that promotes effective and efficient information processing; and (d) the content is delivered in a partnership with students in a manner that facilitates and enriches learning for all students.

To accomplish this, several major assumptions have been made.

1. The content teacher has the responsibility to present information that will promote student understanding and remembering of content to low-achieving students.
2. The process of planning, teaching, and evaluating for learning should be based on careful consideration of the information-processing demands placed on the teacher as well as the student.
3. Enhancements, consisting of carefully planned instructional routines and devices, should be utilized to enhance the delivery of content information.
4. The teacher must inform students of the enhancements that are to be used to enhance the delivery of information, and as a result, student learning.
5. The teacher must cue students when specific enhancements are being used to promote learning.
6. The teacher must purposely implement the enhancement in a partnership with students.
7. The teacher should induce himself/herself and the students to reflect on the enhancement and to evaluate its roles in learning and whether it has been an effective teaching/learning experience.

Therefore, great responsibility is placed on the teacher to become the primary instructional organizer.

The model consists of three major components. The first includes specific teaching routines that might be used to enhance or guide the delivery of major chunks of a content lesson, (e.g., routines designed to orient the students to information that will be learned, routines designed to help students understand concepts, or routines to promote active learning of new material). The second component consists of instructional devices that might be embedded in a routine to further enhance the delivery of content (e.g., devices designed to help the student understand, remember, or organize information). The third component consists of procedures for planning instruction and organizing the content enhancement process daily and over time under both planned and spontaneous circumstances, (e.g., guidance in identifying important information, analyzing prior knowledge requirements of the students). This third component seeks to address how teachers might be able to incorporate adaptive techniques into their normal teaching plans and reduce the negative impact of additional preparation required by some adaptive techniques. (For review of this model, see Lenz, Bulgren, and Hudson, in press, and Schumaker, Deshler, and McKnight, in press).

Although the development of different approaches and models for delivering content to low-achieving students in a more successful manner may be available in the future, the success of current efforts to improve the instructional situation rests in the hands of classroom teachers and publishers. It seems clear that teacher-mediated techniques associated with using study guides, concept maps, graphics, and various mnemonic techniques (e.g., perusing the content to determine the organization of material, producing concept maps and mnemonic graphics, study guides, tests), will require curriculum development activities prior to instructional delivery. If textbook publishers would supplement their texts with materials providing these kinds of instructional aids, teachers would be more likely to employ them in their classes. Unfortunately, publishers rarely include these types of materials. Therefore, individual teachers must produce them or teams of teachers who teach the same course must produce them. But the structure and climate of many schools do not encourage this type of collaboration. If the task is left to individual teachers, however, the task may be overwhelming.

As an alternative, teams of individuals could divide the task into manageable components with each member assigned a specific section of a textbook to develop instructional materials for students to use in mediating the learning process. These members then would share and explain their work with other team members. The process can have many inhibitors as well. For example, many educators who teach content classes in which large numbers of low-achieving students and students with learning disabilities are enrolled often do so as only part of their instructional load. In addition, course material and content may change,

and reaching agreement across teachers on general development goals for a specific discipline may be difficult.

SUMMARY AND CONCLUSION

In summary, it seems clear that educators must attend to content acquisition as well as to skill acquisition in developing appropriate educational programs for low-achieving students and students with mild handicaps. But, with the exception of some of the research efforts described in this article (and possibly others not referenced herein that are consistent with the purposes of these studies), current conceptualizations regarding how skill and content acquisition might be appropriately addressed in a balanced fashion have been unimpressive. Previous efforts have focused either on skill acquisition, with little or no attention to content-area generalization, or on content acquisition through tutoring or content reduction, with little or no concern for skill application or attainment. Neither of these alternatives seems appropriate or acceptable. Concurrently, concern for the decrease in scientific and cultural literacy levels of all students has reached national proportions. Attention to how content can be successfully promoted in the face of student diversity has become an educational issue broader than the concerns expressed by special educators.

In effect, the current attention on content-area instruction could set the stage for unprecedented change over the next 10 years in how instruction in the content areas is accomplished. This change could result in an increase or a decrease in teacher attention to learner-sensitive instruction. In essence, a decrease in an emphasis in learner-sensitive instruction would have devastating effects on the success of low-achieving students in content-area classes. But, prompting a change toward instruction that is more learner sensitive, as discussed in this article, cannot be accomplished through the initiative of special educators alone. Such a change can be realized only when content-area teachers support such a change, embrace the goals of strategic learning and performance, demand instructional environments that promote such an orientation, and, as a result, create their own initiative for improved content-area instruction. The task of concerned special and regular educators is to begin sowing the seeds for such a change.

REFERENCES

Anderson, R. C., & Biddle, W. B. (1975). On asking people questions about what they are reading. In G. Bower (Ed.), *The psychology of learning and motivation* (Vol. 9, pp. 90–132). New York: Academic Press.

Anderson, T. H., & Armbruster, B. B. (1984). Studying. In P. D. Pearson (Ed.), *Handbook of reading research*. New York: Longman.

Anderson, T. H., Armbruster, B. B., & Kantor, R. N. (1980). *How clearly written are children's textbooks? or, of bladderworks and alfa* (Reading Education Report No. 16). Urbana: University of Illinois Center for the Study of Reading.

Armbruster, B. B., & Anderson, T. H. (1988). On selecting "considerate" content area textbooks. *Remedial & Special Education, 9*, 4–52.

Atkinson, R. C., & Raugh, M. (1975). An application of the mnemonic keyword method to the acquisition of a Russian vocabulary. *Journal of Experimental Psychology: Human Learning & Memory, 104*, 126–133.

Ausubel, D. P. (1961). Learning by discovery: Rationale and mystique. *Bulletin of National Association of Secondary School Principals, 45*, 18–58.

Becker, W. C., Engelmann, S., Carnine, D. W., & Maggs, A. (1982). Direct instruction technology: Making learning happen. In P. Karoly & J. J. Steffen (Eds.) *Improving children's competence: Advances in child behavioral analysis and therapy (Vol. 1)*, (pp. 151–204). Lexington, MA: Heath.

Bergerud, D., Lovitt, T., & Horton, S. (1987). *The effectiveness of textbook adaptations in life science for high school students with learning disabilities*. Unpublished manuscript, University of Washington, Seattle.

Brophy, J., & Good, T. (1984). Teacher behavior and student achievement. In M. Wittrock (Ed.), *Third handbook of research on teaching* (pp. 328–375). New York: Macmillian,

Bulgren, J. A., Schumaker, J.B., & Deshler, D. D. (1988). Effectiveness of a concept teaching routine in enhancing the performance of LD students in secondary-level mainstream classes. *Learning Disability Quarterly, 11*, 3–17.

Carlson, S. A., & Silverman, R. (1986). Microcomputers and computer-assisted instruction in special classrooms: Do we need the teacher? *Learning Disability Quarterly, 9*(2), 105–110.

Carnine, D., & Silbert, J. (1979). *Direct instruction reading*. Columbus, OH: Charles E. Merrill.

D'Alonzo, B. J., & Zucker, S. H. (1982). Comprehension scores of learning disabled high school students on aurally presented content. *Exceptional Children, 48*, 35–36.

Dansereau, D. F., & Holley, C. D. (1982). Development and evaluation of a text mapping strategy. In A. Flammer & W. Kintsch (Eds.), *Discourse processing*, (pp. 536–554). Amsterdam, Netherlands: North Holland.

Darch, C., & Carnine, D. (1986). *Content area instruction: The role of information organization, learner strategies, and task structure*. Paper presented at annual meeting of American Educational Research Association, Chicago.

Deshler, D. D., & Lenz, B. K. (in press). The strategies instructional approach. *International Journal of Disability, Development, and Education*.

Deshler, D. D., Lowrey, N., & Alley, G. R. (1979). Programming alternatives for learning disabled adolescents: A nationwide survey. *Academic Therapy, 14*, 415–421.

Deshler, D. D., & Schumaker, J. B. (1988). An instructional model for teaching students how to learn. In J. L. Graden, J. E. Zins, & M. J. Curtis (Eds.), *Alternative educational delivery systems: Enhancing instructional options for all students*. (pp. 391–411). Washington, DC: National Association of School Psychologists.

Deshler, D. D., Schumaker, J. B., Lenz, B. K., & Ellis, E. S. (1984). Academic and cognitive interventions for LD adolescents: Part 2. *Journal of Learning Disabilities, 17*(3), 170–187.

Dupuis, N. M., & Askov, E. N. (1982). *Content area reading*. Englewood Cliffs, NJ: Prentice-Hall.

Ellis, E. S., Courtney, J., & Church, A. (in press). A learning strategy for

meeting the writing demands of secondary mainstream classrooms. *Teaching Exceptional Children*.

Ellis, E. S., Lenz, B. K., & Sabornie, E. J. (1987a). Generalization and adaptation of learning strategies to natural environments: Part 1—Critical agents. *Remedial & Special Education, 8*(1), 6–21.

Ellis, E. S., Lenz, B. K., & Sabornie, E. J. (1987b). Generalization and adaptation of learning strategies to natural environments: Part 2—Research into practice. *Remedial & Special Education, 8*(2), 6–24.

Ellis, E. S., & Sabornie, E. J. (1986). Effective instruction with microcomputers: Promises, practices, and preliminary findings. *Focus on Exceptional Children, 19*, 1–16.

Ellis, E. S., & Sabornie, E. J. (1989). *Strategy-based instruction in content-area classes: Social validity of six options*. Unpublished manuscript, Program for Exceptional Children, University of South Carolina, Columbia.

Gersten, R. (1983). *Direct instruction with special education students: A review of evaluation research*. Unpublished manuscript, University of Oregon, Eugene.

Harber, J. (1983). The effects of illustrations on the reading performance of learning disabled and normal children. *Learning Disability Quarterly, 6*, 55–60.

Hawkins, J. (1988). Antecedent pausing as a direct information tactic for adolescents with severe behavior disorders. *Behavior Disorders, 13*(4), 263–272.

Herber, H. L. (1970). *Teaching reading in content areas*. Englewood Cliffs, NJ: Prentice-Hall.

Horton, S. V., & Lovitt, T. C. (1987). *Information organization for secondary students: Study guides*. Unpublished manuscript, University of Washington, Seattle.

Horton, S. V., Lovitt, T., & Givens, A. (1989). Teaching social studies to learning disabled and remedial high school students in a mainstreamed setting: Effects of a computerized study guide. *Journal of Learning Disabilities, 22*, 102–107.

Hudson, P. J. (1987). *The pause procedure: A technique to help mildly handicapped students learn factual content*. Unpublished dissertation, University of Florida, Gainesville.

Hughes, C. A., Hendrickson, J. M., & Hudson, P. J. (1986). The pause procedure: Improving factual recall from lectures by low and high achieving middle school students. *International Journal of Instructional Media, 13*, 217–226.

Johnson, D. D., & Pearson, P. D. (1978). *Teaching reading vocabulary*. New York: Holt & Co.

Joyce, B., & Weil, M. (1980). *Models of teaching*. Englewood Cliffs, NJ: Prentice-Hall.

Koran, M. L., & Koran, J. (1980). Interaction of learner characteristics with pictorial adjuncts in learning from science text. *Journal of Research in Science Teaching, 1*, 477–483.

Lenz, B. K., & Alley, G. R. (1983). *The effects of advance organizers on the learning and retention of learning disabled adolescents within the context of a cooperative planning model*. Final research report submitted to the U.S. Department of Education, Office of Special Education, Washington, DC.

Lenz, B. K., Alley, G. R., Beals, V. C., Schumaker, J. B., & Deshler, D. D. (1981). *Teaching LD adolescents a strategy for interpreting visual aids*. Unpublished manuscript, University of Kansas, Lawrence.

Lenz, B. K., Alley, G. R., & Schumaker, J. B. (1987). Activating the inactive learner: Advance organizers in the secondary content classroom. *Learning Disability Quarterly, 10*(1), 53–67.

Lenz, B. K., & Bulgren, J. A. (in press). Promoting learning in the content areas. In P. A. Cegelka & W. H. Berdine (Eds.), *Effective instruction for students with learning problems*. Needham Heights, MA: Allyn & Bacon.

Lenz, B. K., Bulgren, J.A., & Hudson, P. (in press). *Content enhancement: A model for promoting the acquisition of content by individuals with learning disabilities*. Proceedings of the Division of Learning Disabilities 1988 Research Symposium, Purdue University, Lafayette, IN.

Lenz, B. K., & Ellis, E. S. (in press). *Designing effective interventions for learning disabled adolescents*. Boston: College Hill Press.

Lenz, B. K., & Mellard, D. P. (1990). Content area skill assessment. In R. A. Gable & J. M. Hendrickson (Eds.), *Error patterns in academics: Identification and remediation*. White Plains, NY: Longman.

Levin, J. R. (1981a). The mnemonic 80's: Keywords in the classroom. *Educational Psychologist, 16*, 65–82.

Levin, J. R. (1981b). On functions of pictures in prose. In F. J. Pirozzolo & M. C. Wittrock (Eds.), *Neuropsychological and cognitive processes in reading* (pp. 203–228). New York: Academic Press.

Levin, J. R. (1983). Pictorial strategies for school learning: Practical illustrations. In M. Pressley & J. R. Levin (Eds.), *Cognitive strategy research: Educational applications* (pp. 213–237). New York: Springer-Verlag.

Lloyd, J. W. (1984). How shall we individualize instruction—or should we? *Remedial & Special Education, 5*, 7–15.

Lovitt, T., Horton, S. V., & Bergerud, D. (1987). Matching students with textbooks: An alternative to readability formulas and standardized tests. *British Columbia Journal of Special Education, 11*(1), 49–55.

Lovitt, T., Rudsit, J., Jenkins, J., Pious, C., & Benedetti, D. (1985). Two methods for adapting science materials for regular and learning disabled seventh graders. *Learning Disability Quarterly, 8*, 275–285.

Mastropieri, M. A., Scruggs, T. E., McLoone, B., & Levin, J. R. (1985). Facilitating the acquisition of science classifications in learning disabled students. *Learning Disability Quarterly, 8*, 299–309.

Meyer, B. J. F. (1981). Basic research on prose comprehension: A critical review. In D. F. Fisher & C. W. Peters (Eds.), *Comprehension and the competent reader: Interspeciality perspective*. New York: Praeger.

Miller, K. (1983). *An analysis of minimal competency testing requirements as applied to learning disabled students*. Unpublished doctoral dissertation, University of Kansas, Lawrence.

Mosby, R. (1979). A bypass program of supportive instruction for secondary students with learning disabilities. *Journal of Learning Disabilities, 12*, 187–190.

Mosby, R. (1980). The application of the developmental-by-pass procedure to LD adolescents. *Journal of Learning Disabilities, 13*, 21–22.

Moyer, J. C., Sowder, L., Threadgill-Sowder, J., & Moyer, M. B. (1984). Story problem formats: Drawn versus telegraphic. *Journal for Research in Mathematics Education, 15*, 342–351.

Palincsar, A. M., & Brown, A. L. (1984). Reciprocal teaching of comprehensive fostering and monitoring activities. *Cognition & Instruction, 1*, 117–175.

Pressley, M. (1977). Imagery and children's learning: Putting the picture in developmental perspective. *Review of Educational Research, 47*, 586–622.

Pressley, M., Johnson, C. J., & Symons, S. (1987). Elaborating to learn and learning to elaborate. *Journal of Learning Disabilities, 20*, 76–91.

Reder, L. M. (1985). Techniques available to author, teacher, and reader to improve retention of main ideas of a chapter. In S. F. Chipman, J. W. Segal, & R. Graser (Eds.), *Thinking and learning skills: Vol. 2, Research and open questions* (pp. 37–63). Hillsdale, NJ: Erlbaum.

Riley, J. D. (1979). The effect of reading guides upon students' literal, interpretive, and applied level comprehension of word problems. In H. L. Herber & J. D. Riley (Eds.), *Research in reading in the content areas: Fourth year report* (pp. 79–97). Syracuse, NY: Syracuse University Reading and Language Arts Center.

Roehler, L. R., & Duffy, G. G. (1984). Direct explanation of comprehension processes. In G. G. Duffy, L. R. Roehler, & J. Mason (Eds.), *Comprehension instruction: Perspectives and suggestions* (pp.

265–280). New York: Longman.

Rosenshine, B. (1979). Content, time, and direct instruction. In P. L. Peterson & H. L. Walberg (Eds.), *Research on teaching: Concepts, findings, and implications* (pp. 28–56). Berkeley, CA: McCutchan.

Rosenthal, T. L., & Zimmerman, B. J. (1978). *Social learning and cognition*. New York: Academic Press.

Rowe, M. B. (1976). The pausing principle: Two invitations to inquiry. *Research on College Science Teaching, 5*, 258–259.

Rowe, M. B. (1980). Pausing principles and their effects on reasoning in science. *New Directions in Community Colleges, 31*, 27–34.

Rowe, M. B. (1983). Getting chemistry off the killer-course list. *Journal of Chemical Education, 60*, 954–956.

Sawyer, D. J., & Kosoff, T. O. (1981). Accommodating the learning needs of reading disabled adolescents: A language processing issue. *Learning Disability Quarterly, 4*, 61–68.

Schallert, D. L. (1980). The role of illustrations in reading comprehension. In R. J. Spiro, B. C. Bruce, & W. F. Brewer (Eds.), *Theoretical issues in reading comprehension: Perspectives from cognitive psychology, linguistics, artificial intelligence, and education* (pp. 503–524). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schumaker, J. B., Denton, P., & Deshler, D. D. (1984). *The learning strategies curriculum: The paraphrasing strategy*. Lawrence: University of Kansas.

Schumaker, J. B., & Deshler, D. D. (1984). Setting demand variables: A major factor in program planning for LD adolescents. *Topics in Language Disorders Journal, 4*, 22–44.

Schumaker, J. B., Deshler, D. D., Alley, G. R., Warner, M M., & Denton, P. (1982). Multipass: A learning strategy for improving reading comprehension. *Learning Disability Quarterly, 5*, 409–414.

Schumaker, J.B., Deshler, D. D., & Ellis, E. S. (1986). Intervention issues related to the education of LD adolescents. In J. K. Torgesen & B. Y. K. Wong (Eds.), *Psychological and educational perspectives on learning disabilities* (pp. 239–365). Columbus, OH: Academic Press.

Schumaker, J. B., Deshler, D. D., & McKnight, P. C. (in press). *Teaching routines for content areas at the secondary level*. Washington, DC: National Association for School Psychologists.

Scruggs, T. E., Mastropieri, M. A., Levin, J. R., McLoone, B., Gaffney, J. S., & Prater, M. A. (1985). Increasing content-area learning: A comparison of mnemonic and visual-spatial direct instruction. *Learning Disabilities Research, 1*, 18–31.

Torgesen, J., & Licht, B. (1983). The learning disabled child as an inactive learner: Retrospect and prospects. In J. D. McKinney & L. Feagans (Eds.), *Topics in Learning Disabilities* (Vol. 1). Rockville, MD: Aspen.

Voss, J. F. (1982, March). *Knowledge and social science problem solving*. Paper presented at AERA meeting, New York City.

Wiederholt, J. L., & McEntire, B. (1980). Educational options for handicapped adolescents. *Exceptional Education Quarterly, 1*, 1–10.

Wisemen, D. E., Hartwell, L. K., & Hannafin, M. J. (1980). Exploring the reading and listening skills of secondary mildly handicapped students. *Learning Disability Quarterly, 3*, 56–61.

Wong, B. Y. L. (1985a) Metacognition and learning disabilities. In T. G. Waller, D. Forrest-Pressley, & E. MacKinnon (Eds.), *Metacognition, cognition and human performance* (pp. 137–180). New York: Academic Press.

Wong, B. Y. L. (1985b). Potential means of enhancing content skills acquisition in learning disabled adolescents. *Focus on Exceptional Children, 17*(5), 1–8.

Zigmond, N., Levin, E., & Laurie, T. (1985). Managing the mainstream: An analysis of teacher attitudes and student performance in mainstream high school programs. *Journal of Learning Disabilities, 18*, 535–541.

INDEX • VOLUME 22

Author Index

Chronological Index of Titles