READING COMPREHENSION INSTRUCTION FOR SECONDARY STUDENTS: CHALLENGES FOR STRUGGLING STUDENTS AND TEACHERS

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Abstract. **This article describes research on reading comprehension instruction with secondary students with learning disabilities. Specific difficulties for the struggling reader at the secondary level are described, followed by a review of reviews of the reading comprehension instruction research. Specific details from the most promising practices that have scientific evidence are highlighted. These practices include peer tutoring that incorporates comprehension strategy instruction and elaborative strategies in history and science classes. Research using *Inspiration* software to generate spatially organized graphic organizers to facilitate comprehension of content-area instruction is presented. Finally, implications for practice and for future research are discussed.**

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Struggling readers at the secondary level must overcome many challenges in order to succeed in school. One obvious challenge is the disparity between their reading ability and the required reading materials in middle and high school. Many struggling readers with learning disabilities at the secondary level read on a fourth- and fifth-grade level, but the adopted textbooks at their respective high schools are at grade level. Frequently, secondary school content-area textbooks readability levels are even higher than the assigned grade levels. For example, Kinder, Bursuck and Epstein (1992) reported readability levels ranging from ninth grade to third year of college, with a mean of a tenth-grade level, for social studies textbooks adopted at the eighth-grade level. Moreover, many researchers have noted that textbooks are the major instructional resource in classes (Bean, Zigmond, & Hartman, 1994; Okolo & Ferretti, 1996). Such findings demonstrate the enormity of the difficulties encountered by secondary students who are struggling readers.

Another challenge for struggling readers is the unfriendly nature of most content-area textbooks. Armbruster and Anderson (1988) reported that textbooks frequently lack "considerateness," in that they are inconsistently organized from chapter to chapter, lack good structure, provide insufficient definitions of essential vocabulary, and require inappropriate skill demands of learners. Science and social studies textbooks pursue breadth over depth in content coverage; consequently, enormous amounts of content are

introduced with little in-depth coverage or elaboration. Content textbooks typically do not present material in a reader-friendly fashion, but instead contain densely worded paragraphs that include an overwhelming number of concepts, facts and details with insufficient explanation (see also Beck, McKeown, & Gromoll, 1989). Further, content-area textbooks introduce significant numbers of new vocabulary words. Yager (1983) analyzed the amount of vocabulary introduced in science textbooks and concluded that more vocabulary words were introduced in a single year of science than in the first year of a foreign language class. Following is an example from a high school chemistry text:

> In most polymers, like polyethylene and cellulose, the monomers are all identical. In other cases, such as proteins, different monomers may be combined. Although the amino acid monomers that make up proteins appear to be very different, each one has an amino functional group and an organic acid functional group, so the monomers all link in the same way, forming a "backbone" of carbon, nitrogen, and oxygen atoms. A polymer with three amino acids is called a *tripeptide*. (Tocci & Viehland, 1996, p. 257)

Compounding the issue of text density and complexity is the fact that this single paragraph occupies perhaps 15% of the space of one page of an 848-page book, resulting in a text that is also overwhelming in the volume of content presented.

Another challenge is the pace at which teachers proceed through the content. Thus, a pace of one class session per chapter is very common; recently, many teachers have increased the pace of instruction as a consequence of the pressures of end-of-school-year high-stakes testing (Frase-Blunt, 2000). Some students find that teachers are introducing the next set of concepts before they have had time to understand the previously introduced content. Since the curriculum in many classes builds from unit to unit, these students often become more and more lost and frustrated as the school year progresses. In chemistry classes, for example, if students do not learn the initial content on the periodic table of elements, they will experience difficulties throughout the year as more complex problems involving applications of the periodic table are required. Similar challenges are noted in algebra; for example, if students fall behind during the introduction of solutions of one-step algebraic problems, two-step problems may not only appear completely overwhelming, they may be impossible due to students' lack of prerequisite skills.

Struggling secondary students also appear challenged due to the demands placed on overworked and frequently unlicensed secondary education teachers. Many high school teachers in science and math only have provisional teaching licenses and are struggling themselves to learn how to teach effectively on the job. This means that all students do not receive the optimal instruction in these content-area classes. Teachers' lack of knowledge about how to teach effectively may be especially weak for working with students who are unable to learn with traditional methods. For example, in an intensive qualitative study in high school science and social studies classes, Scruggs and Mastropieri (2002) found that when teachers were not licensed, they lacked (a) knowledge about effective classroom management, (b) effective teaching strategies, (c) content-area knowledge, and (d) specific ways to adapt instruction to meet the needs of students with disabilities (see also Nougaret, 2002). Teachers relied heavily on the adopted textbooks for the major instructional medium, but instruction in reading comprehension strategies was missing from their repertoire of teaching behaviors. These observations are supported by recent quantitative research documenting the pedagogical shortcomings of unlicensed teachers (Nougaret, 2002).

These deficiencies impacted both teachers and students. For example, teachers were frustrated because students acted inappropriately during class, performed inadequately on homework, lab and class assignments, and did poorly on class tests. Teachers rarely reflected on their own insufficient teacher preparation or lack of teaching skills, blaming poor student performance on low motivation and lack of interest in school and content-area classes. One teacher reported in desperation "If I could only get them to sit in their seats and listen ..." (Scruggs & Mastropieri, 2002, p. 14). Student frustration exacerbated inappropriate class behavior that contributed to poor grades and low performance on statewide high-stakes testing linked to graduation requirements.

Scruggs and Mastropieri (2002) concluded that a vicious cycle of teachers blaming students and students blaming teachers is especially unhelpful to struggling secondary students with disabilities in content-area classes. What appears critical is the dissemination of classroom management strategies, effective instruction strategies, especially in the area of reading comprehension, that teachers can use for successful secondary content-area instruction.

READING COMPREHENSION RESEARCH

Reading comprehension research has increased significantly our knowledge of best practices for instructing students to comprehend better. Several major syntheses of the research in reading comprehension

instruction and interventions with students with learning disabilities have added to the knowledge base of effective strategy instruction for students with disabilities (Mastropieri, Scruggs, Bakken, & Whedon, 1996; Swanson, 1999a, 1999b; Swanson, Hoskyn, & Lee, 1999; Talbott, Lloyd, & Tankersley, 1994).

Talbott et al. (1994) reported an overall effect size of 1.13 from a meta-analysis of 48 group research studies implemented with students with learning disabilities. Mastropieri et al. (1996) reported an overall effect size of .98 for group research studies on an evaluation of 82 group and single-subject research studies conducted in reading comprehension with students with learning disabilities, and similar effects for the single-subject studies. More recently, Swanson and colleagues (Swanson, 1999a, 1999b; Swanson et al., 1999) completed an extensive meta-analysis on all interventions with students with learning disabilities and reported an overall effect size on reading comprehension measures of .82. Taken together, these research syntheses provide direct evidence that specific interventions in reading comprehension have produced significant positive outcomes for students with learning disabilities.

Specific instructional procedures from highly effective reading comprehension studies were also revealed in these reports. For example, Swanson's (1999a) findings indicated that a combination of strategy instruction and direct instruction appeared to produce the most powerful effects, along with the addition of multiple instructional components. Components of effective instruction and features of his model are included in Table 1. Swanson concluded that an additive effect was seen in that interventions that included more of these components produced the most robust gains in reading comprehension.

Mastropieri et al. (1996) subdivided effective reading comprehension interventions into the following categories: basic skills and reinforcement studies; text enhancement studies; and self-questioning studies. Interventions with the lowest effect sizes, basic skills and reinforcement studies, required the least amount of teacher preparation time, while those with higher effect sizes, text enhancements and self-questioning strategies, required more teacher preparation time and more student learning time. Table 2 lists the effect sizes obtained for each major area and samples of the effective intervention strategies by category.

The average age of the students in that synthesis sample was 13 years, but the mean effect size for students younger than 13 years of age (.93) was highly similar to the mean effect size for students older than 13 (1.00). This indicates that the strategies in this data set were equally effective for students older and younger than 13 years of age. Moreover, a set of common instructional features were identified, as listed in Table 3.

Table 1
Swanson's Effective Intervention Research Components

Instructional Components	Strategy Instruction Model	Direct Instruction Model
• One-to-one instruction	• Strategy	• Breaking downs tasks by skills
• Control difficulty or processing demands of tasks	• Cognitive intervention	• Probes of learning
• Technology: formal curriculum and pictorial representations	• Monitoring	• Instruction broken into individual steps
• Elaboration	• Metacognition	• Modeling of skills by teacher
• Modeling of steps by teacher	• Self-instruction	• Teacher presenting new material
• Group instruction (small groups)	• Cognitive-behavioral interventions	• Distributed practice
• Supplement to teacher involvement besides peers (e.g., parents or homework)	• Teacher providing only necessary information	
• Strategy cues	• Think-aloud models	

Table 2

Mastropieri, Scruggs, Bakken and Whedons's Effect Sizes by Reading Comprehension Area and Strategies

Basic Skill and Reinforcement	Text Enhancements	Self-Questioning
Effect Size: .62	Effect Size: .92	Effect Size: 1.33
Vocabulary	Illustrations	Activating prior knowledge
Corrective feedback	Representational illustrations	Summarizing
Repeated readings	Imagery	Finding main ideas
Direct instruction	Spatial organizers	Self-monitoring
Corrective feedback	Mnemonic illustrations	Attributions
Repeated readings	Adjunct aids	Packages of strategies
		Text-structure-based strategies

Table 3

Effective Intervention Components

- Use clear objectives
- Follow specific sequence for teaching
  - state the purpose
  - provide instruction
  - model
  - guided practice
  - corrective feedback
  - independent practice
  - generalization practice
- Inform the students of importance of the strategy
- Monitor performance
- Encourage questions that require students to think about strategies and text
- Encourage appropriate attributions
- Teach for generalized use of the strategy

One example of a questioning strategy is a basic summarization or paragraph restatement strategy (e.g., Jenkins, Heliotis, Stein, & Haynes, 1987; Malone & Mastropieri, 1992). Students are taught how to ask and answer the summarization strategy questions as they read, as follows:

- Who or what is the paragraph about?
- What is happening to the who or what?
- Create a summary sentence in your own words using less than 10 words.

Some studies have added the effects of including self-monitoring components to the strategy so students are required to check off strategy steps as they are completed. Using the identified instructional components, researchers have used very systematic instruction in the initial introduction of this strategy, provided guided and independent practice opportunities, and encouraged independent strategy use. The positive findings appear to be due to several important features. First, students are required to interact more with text as they are reading. Second, they are given simple strategy steps to assist them in interacting with the text. And, sound instructional practices are used in introducing and teaching the strategy to students. All these instructional components are highly similar to those identified by Swanson (1999a) and have also been incorporated into some recent peer-tutoring studies.

PEER-TUTORING RESEARCH INVOLVING STUDENTS WITH LEARNING DISABILITIES

Peer tutoring has gained popularity over the years and is backed by some very impressive research evidence to support its use to improve academic performance (see Topping & Ehly, 1998, for reviews). The

majority of previous research on peer tutoring has been implemented at the elementary level (see Fuchs, Fuchs, Mathes, & Simmons, 1997; Greenwood, Carta, Kamps, & Hall, 1988). For example, it has been documented that peer tutoring has improved reading and math skills for students with and without disabilities (Mastropieri, Spencer, Scruggs, & Talbott, 2000).

Fewer peer tutoring studies have been completed at the middle and secondary levels (e.g., Fuchs, Fuchs, & Kazdan, 1999; Maheady, Sacca, & Harper, 1988); however, existing studies offer some interesting findings for potential best practice and emerging best practice at the middle and secondary level. Some studies teaching reading comprehension strategies during peer tutoring have been implemented recently in remedial reading classes, in English classes at the middle and secondary levels, in high school world history classes, in middle school social studies classes, and in high school chemistry classes. Each area of inquiry is described separately next (see also Mastropieri, Scruggs, Graetz, et al., 2002).

Peer Tutoring in Reading Comprehension Strategies in Remedial Reading Classes

Fuchs et al. (1999) investigated the effects of peer-assisted learning strategies (PALS) on reading fluency, reading comprehension, and attitudes toward reading. Eighteen special education and remedial reading teachers in 10 high schools were assigned to PALS or contrast treatments. PALS was implemented five times every two weeks over a 16-week period. The PALS strategies started out with Partner Reading, where students take turns reading connected text for five minutes. The next PALS strategy is Paragraph Shrinking, in which students ask each other (a) who or what is the paragraph about, and (b) the most important thing about the who or what (Fuchs et al., 1999). Students are expected to put the two pieces of information together in 10 words or less, while the partner provides feedback. In the last activity, Prediction Relay, the reader makes a prediction about what will be learned on the following half page. The reader then reads the passage, confirms or disconfirms the prediction, and summarizes the main idea of the passage. Contrast teachers implemented reading instruction using their conventional procedures, which did not employ peer-mediated learning activities. After 16 weeks of intervention, Fuchs et al. (1999) reported that students in the PALS condition evidenced significantly greater growth (1.5 greater) in reading comprehension than students in classrooms that did not use PALS. Differences were not observed between conditions on reading fluency or attitudes, however.

Peer Tutoring in Reading Comprehension Strategies During English Classes

Mastropieri, Scruggs, Mohler, et al. (2001) randomly assigned struggling readers to either traditional teacher-led instruction or a comprehension strategy-based peer tutoring condition during seventh-grade English classes. Students in the tutoring condition were explicitly trained to use the three-step summarization strategy described previously with partners during English classes. The study replicated and modified the PALS model procedures developed by Lynn and Doug Fuchs and colleagues (e.g., Fuchs, Mathes, & Fuchs, 1995). Dyads were created based on student reading levels, with each dyad containing a higher- and lower-level reader. Tutoring procedures were clearly introduced by teachers, including rules and procedures for tutoring. Sample rules included trying your best; talking in quiet voices; and cooperating with partners. All students were middle school-aged seventh graders with serious reading difficulties. Either tutoring or traditional reading instruction occurred during the daily scheduled English classes. Tutoring procedures included the use of Partner Reading and the implementation of the summarization strategy instruction and practice. The higher-performing reader read the selection first, followed by the lower-performing reader reading the same selection. During the oral reading, partners provided corrective feedback if errors were detected. If words were encountered unknown to either partner, they raised their hands for teacher assistance. Immediately following the completion of the second reading, the higher-performing reader asked the lower-performing partner the comprehension questions: What was the paragraph about? What was happening to the who or what? What is a summary sentence in your own words? The lower-performing readers then asked their partners the same questions. These procedures were repeated throughout the peer tutoring session.

In the traditional instruction condition, students received the same type of instruction that had been taking place all year in school using the same materials that were implemented in the tutoring condition. The instruction was teacher-led and contained round-robin oral reading, silent reading, accompanying worksheets, and teacher questioning for comprehension.

After five weeks, students in the tutoring condition significantly outperformed their control peer counterparts, with means of 81.8% versus 63.3% on criterion-referenced reading comprehension measures. Student and teacher observational and interview findings were also obtained. Students in the tutoring condition reported that they liked: (a) spending more time reading during tutoring than during traditional English class activities; (b) reading to a single partner than in front of an entire class of students and a teacher; and (c) working with peers tutoring. They also expressed interest in using peer tutoring in other subject areas. However, students also expressed concerns surrounding their partners and

the decoding and comprehension activities. Some students disliked teachers assigning partners and wanted to select their own partners. Further, many students encountered difficulties with decoding. At times neither partner could decode the text, while in some pairs, students could not read as fast as their partner's reading rate and experienced difficulties keeping up. Many students reported problems with the summarization strategy. Initially, it was extremely difficult for most students to ask and answer the comprehension questions. Although they improved over time with practice, they still reported that it was very hard to ask and answer the comprehension question. Clearly, the comprehension strategy component was challenging. This indicates that the students were unfamiliar with using meta-comprehension strategies during reading and rarely monitored their own comprehension by asking and answering questions about the text. Thus, the tutoring provided a vehicle for the students to learn and practice a critical comprehension monitoring strategy. Moreover, the tutoring provided teachers a vehicle for introducing a comprehension strategy that included repetitive practice, which is necessary for students with learning disabilities.

Teachers in the study also reported both benefits and challenges with implementing the peer tutoring with students who were struggling readers. Reported benefits included enjoying the tutoring, acknowledging the value-added component of reading comprehension strategy instruction, and reporting that more instructional time was devoted to reading during tutoring activities. Challenges included handling absences, monitoring dyads, and making appropriate dyad matches (see also Maheady, 1998). For example, when partners were absent, teachers needed to decide whether to forms groups of three with another tutoring pair or keep a student by himself or herself. Given both the volatile nature of some students with disabilities and the disparate reading levels, teachers frequently decided to form a dyad of "one" and would rotate with that student for part of the tutoring session. When this happened, teachers were unable to circulate as much as necessary among remaining dyads to assist with decoding errors. It was also complicated to make good matches for tutoring pairs since all students were struggling readers and several also had behavior problems. Finally, teachers found that mixed-gender dyads were almost completely unworkable in these seventh-grade classes.

Armani, Mastropieri, and Scruggs (2001) replicated these procedures in ninth-grade classes of students with reading difficulties. As before, students were randomly assigned to tutoring and traditional instruction during their English classes. Tutoring took place during reading of the assigned book, *Animal Farm.* Instruction was co-taught by general and special educators. The special educator initiated the tutoring and introduced the tutoring roles, procedures, and tutor monitoring checklists. Procedures paralleled those completed in the seventh-grade classes described earlier. In the present co-teaching situation, the special education teacher assumed more responsibilities during instruction than had typically occurred during these English classes in the tutoring condition. The general educator assumed more responsibilities for all instruction during traditional instruction consisting of teacher presentation of material, round-robin class oral reading, class discussion, and relevant worksheets addressing the story.

The intervention occurred throughout the length of time necessary to cover the novel. Dependent measures included oral reading fluency, comprehension, and recall from the story. This time, no significant differences on these measures were obtained between treatment conditions. Although the special education teacher reported that she liked the tutoring, she noted that the general education teacher was not receptive to the intervention, was at times reluctant to give up what he considered "valuable instructional time," and was hesitant to follow through with allowing the special educator sufficient time to implement the tutoring procedures with the students.

This inconsistent finding raises important questions that need to be addressed. One concern is the receptivity of secondary teachers to implementing evidence-based practices in their classes (Scruggs & Mastropieri, 1996). Many researchers have observed that fidelity of treatment implementation and teacher attitude toward interventions influence profoundly the impact of any intervention. Another concern is whether co-teaching is successful at improving student performance.

Although co-teaching has been widely embraced by school districts across the country, solid evidence supporting its efficacy is missing (see Weiss & Brigham, 2000; Zigmond & Magiera, 2000, for reviews). Boudah, Schumaker, and Deshler (1997) found that the performance of high school students with disabilities actually worsened after co-teaching was implemented. Murawski (2001) reported that co-teachers may be lacking in many of the skills necessary for successful co-teaching to occur. Further, Hardy (2001) found that very little differentiation of teaching happened during high school co-taught science classes. Taken together, these findings raise questions regarding whether otherwise efficacious interventions are changed dramatically once the variable of co-teaching is introduced.

Peer Tutoring in Reading Comprehension During Social Studies Classes

Maheady and colleagues completed several investigations using peer tutoring in secondary content areas that yielded successful improvement in class performance (e.g., Maheady et al., 1988). The nature of the tutoring in these studies consisted of tutors and tutees reviewing fact sheets of important content. Two more recent studies have extended the Mastropieri, Scruggs, Mohler, et al. (2001) reading comprehension strategy procedures to social studies content-area learning at the secondary level (Mastropieri, Scruggs, Spencer, & Fontana, 2003; Spencer, Scruggs, & Mastropieri, 2003). Both studies replicated and extended the investigation to accommodate the requirements of content-area textbook learning.

In the first study, Mastropieri, Scruggs, Spencer, and Fontana (2003) replicated and extended the procedures to tenth-grade world history classes in which tutoring or traditional instruction occurred over a nine-week marking term. Students participated as both tutors and tutees, used the Partner Reading procedure in which the stronger reader always read first, followed by the reading of the same passage by the tutoring partner. Students were given the names of "admirals" and "generals" to designate reading order, but they were not informed who was the higher-level reader. Following the second reading students worked collaboratively on asking and answering the questions, "Who or what was the paragraph about?"; "What was happening to the who or what?"; and "Write a summary sentence" using the answers to their questions. Students were required to write up their responses separately, but were allowed to assist one another in generating the answers. Teachers reviewed answers to the questions with the class as a whole, while students had opportunities to share their responses and to alter their answers if necessary. Students were required to complete this activity on a paragraph-by-paragraph basis.

Initially, the summarization strategy activity was very difficult for the majority of students. It appeared that these students were completely unfamiliar with asking and answering themselves comprehension questions from their world history textbooks, and therefore required additional guidance and assistance while learning the strategy. Once students gained more facility with the strategy, they were instructed to read three paragraphs and then complete the comprehension activity. Summary sheets containing important facts and concepts from the chapters were also developed and used during the tutoring session. These sheets were used as supplements during peer tutoring when the pairs had completed reading the chapter.

Traditional instruction consisted of teacher presentation, oral and silent reading of the textbook, answering questions in the text, and completing relevant worksheets and study-guided notes activities. Instruction took place over a marking quarter. Dependent measures included pre- and post-fluency and comprehension measures and content-area test performance. Findings revealed that performance on content tests was significantly higher in the tutoring condition, and that students in the tutoring condition performed higher on the end-of-year school exam on content covered during the tutoring intervention than students in the traditional instruction condition. Briefly, students in the tutoring condition had improved significantly at writing summaries of texts, learned the comprehension strategy, and reported enjoying participating in the tutoring. Several students in the tutoring condition reported that this had been the fastest marking quarter ever in school, indicating that they not only enjoyed the tutoring but that the time went by faster for them. However, no significant differences were found between conditions on measures of oral reading fluency.

Student and teacher reports corroborated those from the previous study in that tutoring instruction was seen as a benefit to students in several important ways. First, students spent more time reading. Second, comprehension strategy instruction was incorporated within world history instruction. Third, student performance on content-area tests improved significantly. Finally, students enjoyed the tutoring. Nevertheless, some of the challenges that were identified previously remained, such as teacher concerns over making optimal dyad matches, handling absences, and being stretched thin during tutoring instruction. In addition, the pace of covering the content was somewhat slower since each student read the content before answering the comprehension strategy questions. Finally, many students reported that they felt it unnecessary to read the content twice. In spite of the challenges, however, this investigation represented an important extension of previous work.

Spencer, Scruggs, and Mastropieri (2003) replicated the Mastropieri and colleagues studies with a sample of middle school students with emotional disabilities. In a crossover design in which each student participated in both traditional instruction and peer tutoring, Spencer et al. replicated all instructional procedures as conducted in the previously described study. Students were called admirals and generals, tutoring rules, roles, and procedures were identical, the same summarization strategy was implemented, and similar fact review sheets were designed to accompany the relevant chapters in the social studies textbooks (seventh-grade

American history and eighth-grade civics). However, this time, all students were attending a separate setting school for students with serious emotional disabilities.

Following a four-week period in which each student had participated in traditional instruction for two weeks and peer tutoring for two weeks, results indicated that when under peer tutoring instruction, students' recall of content information was significantly higher, and that their classroom and on-task behavior was significantly improved. Teachers and students reported enjoying tutoring, although both felt that reading the same passage twice was neither necessary nor desirable.

Taken together, these extensions to content-area learning are important. These studies provide preliminary evidence that teachers can implement a simple summarization strategy effectively using peer tutoring as a vehicle for extended practice on reading comprehension skills, while increasing the learning of the content-area information.

Peer Tutoring in Comprehension and Elaborative Strategies During Chemistry Classes

Scruggs, Mastropieri, and Graetz (2002) implemented a variation on the peer-tutoring studies described earlier in high school chemistry classes. Fifty-five students with and without disabilities who were instructed in inclusive co-taught classrooms participated. Reciprocal tutoring was implemented such that all students served as tutors and tutees during the sessions. Sessions consisted of approximately 15-20 minutes out of a 90-minute block scheduled chemistry class.

Researchers and teachers worked closely together to identify critical content-area needs for all students. Adopted textbooks (Smoot, Smith, & Price, 1995; Tocci & Viehland, 1998) and the Virginia Standards of Learning for High School Chemistry (2000) were used as the major sources for content. Content that was linked to statewide high-stakes tests was identified as the most critical content for students to learn during the year. Consequently, tutoring materials were developed based on that content. The basic tutoring format remained similar to that in the previous studies. Tutoring rules, roles, and procedures were modified slightly based on teacher input to meet the needs of tenth graders in inclusive chemistry classes. When assigning dyads, only one member of a tutoring dyad was a student with disabilities. Further, tutoring was designed to be a supplement to teacher instruction and to provide extra assistance on learning critical content.

Tutoring materials were designed to meet the high content-area learning demands of chemistry and the more sophisticated learning needs of tenth graders who are enrolled in chemistry classes. Chemistry contains very complex concepts, facts, and vocabulary that build cumulatively throughout the academic year. In addition, students are required to have knowledge of complex problem-solving procedures in order to be able to solve many chemistry problems. For example, learning information about the periodic table of elements is necessary for completing application problems that require such knowledge. Chemistry textbooks are complex and introduce concepts at a rapid rate with insufficient explanation for many students with disabilities.

Materials designed for this study provided tutoring practice in learning content with mnemonic or elaborative strategies (e.g., Scruggs & Mastropieri, 1990) embedded that could be used or omitted depending on students' needs. This component seemed critical, given the nature of the students enrolled in these inclusive classes. That is, some students required the use of additional learning strategies, while others clearly did not. In addition, the materials included questioning that required students to generate more complex responses requiring enhancements to the information. Tutoring materials were designed on 8.5 by 11 inch laminated cards with a 5 by 8.5 inch card attached that contained a picture of the strategy that could be flipped over to show tutees whenever needed. All cards contained several questions, the strategy, illustration, and answers.

For example, one card contained the item: "What is the periodic table?" with the answer: "A tabular arrangement of all known elements, organized by properties." If students needed assistance with that response, the following strategy was embedded: "Think of the word 'table' for the chart for the periodic table, and then think of this picture of the table containing all of the elements." Simultaneously, tutors would show students a picture of the periodic table and then remind them to think of the strategy to help them remember the answer. Following this, tutors asked the same question. If students knew the response, tutors were directed to the next question: "What else is important about the periodic table?" Sample relevant responses were included on the tutoring materials, for example,

- Properties are arranged by periods (rows) and groups (columns).
- The following increase across periods: mass, electron affinity, and ionization energy.
- The following increase across groups: reactivity and atomic radius.

Once students had adequately answered that question, tutors were directed to the next question: "What are components of the periodic table?" Possible answers included: "alkali metals, alkaline earth metals, transition elements, metalloids, noble gases, lanthanides, and actinides."

The materials for teaching about groups on the periodic table consisted of the question, "What are groups on the periodic table?," followed by the response, "Groups are columns of elements on the periodic table. They share common properties." The strategy to be used if needed was,

> Think of the word "growing" for groups. Then think of this picture of "growing up and down" [with a picture of a tree next to a column or group from the periodic table] to help you remember that groups of elements are arranged up and down in columns on the periodic table.

Students were then prompted to remember the strategy and asked the question again. The enhancement questions were: "What else is important about groups?" "What is an example of a group?" "What are characteristics of groups?"

Keyword strategies were embedded when appropriate. For example, to learn about moles and molarity two separate materials were developed. The first asked "What is a mole?," the response being: "Atomic weight in grams of an element or a compound." For this, the strategy was,

> Think of the word "mole." Then, think of this picture of a mole on a scale looking at his weight in grams to help you remember that a mole is the atomic weight in grams of an element.

To teach that molarity meant the concentration of a solute in a solution or the moles per liter, the same picture of the mole was used in the following way:

> Think of the word "moles" for mole and remember this picture of a number of moles in a solution [the picture showed several moles in a beaker with a solution in it] to remember molarity is the concentration of a solute in a solution, in moles per liter.

These materials also contained follow-up questions. The strategy was optional and used only when needed by students. See Figures 1 and 2 for illustrative examples of these materials.

Figure 1. What is a mole?

What is a mole?

Your weight in grams is …

Atomic weight in grams of an element or compound

If your partner is correct, go to ⇒
If your partner doesn't know the answer, review the strategy.

Strategy: Think of the word "mole." Then, think of this picture of a mole on a scale looking at his weight in grams to help you remember that a mole is the atomic weight in grams of an element.

Then ask: *What is the strategy to remember mole?*

Then ask again: *What is a mole?*

⇒ Then ask: *What else is important about moles?* [Answers include: The mole serves as a bridge between the invisible world of atoms and the macroscopic world of materials and objects]

Then ask: *What is an example of a mole?* [Answers include: O (oxygen) is atomic weight 16, so 1 mole O = 16 grams O]

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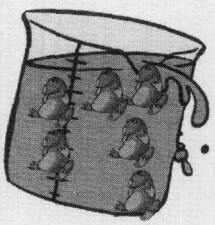
Figure 2. What is molarity?

What is molarity?



Concentration of a solute in a solution; moles per liter.

If your partner is correct, go to ⇒
If your partner doesn't know the answer, review the strategy.

Strategy: Think of the word "moles" for mole, and remember the picture of a number of moles in solution to remember molarity is the concentration of a solute in a solution, in moles per liter.

Then ask: *What is the strategy to remember molarity?*

Then ask again: *What does molarity mean?*

⇒ Then ask:

What else is important about molarity?

[Answers include: molarity is a ratio, moles of solute divided by liters of solution]

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Tutoring partners recorded in their individual folders the dates items were introduced and mastered. Folders containing approximately five to seven pieces of information were color coded, and students were asked to completely master the content in one folder before moving on to the next folder. This individual pacing of content was designed to accommodate students who learned at different rates. Initially, students began to check off that they had mastered everything immediately. Upon noticing this, the teacher announced to the class, "Since it appears that everyone has learned all of the content, that means everyone is ready for a quiz, right?" After hearing this, students immediately began erasing checkmarks indicating that they had mastered the content, instead putting down that they had reviewed the content.

Students were pre- and posttested on the content. Results indicated that students learned significantly more chemistry content when they used the tutoring materials. While typically achieving students gained about 16% over traditional instruction conditions, students with disabilities gained about 43% (the group-by-condition interaction was not significant, however). Students appeared to enjoy using the materials more when they needed assistance. That is, teachers reported that students with disabilities and lower-performing students appeared to prefer using the materials more than other students. These preliminary findings support the use of tutoring using more complex elaborative strategies during a highly complex content-area class.

Spatial Organizers and Computer-Assisted Instruction

Studies examining the effects of spatial organizers on reading comprehension have yielded some promising results (e.g., Mastropieri et al., 1996). Research has also been conducted on the effects of using computer-assisted instruction for facilitating reading comprehension (see Swanson, 1999a). *Inspiration* is a widely

available software program that facilitates the creation of spatial organizers and can be used to help students comprehend information. This program allows the creation of various organizers that are printable in both the organizer view and a more traditional outline view. Anderson-Inman, Knox-Quinn, and Horney (1996) provided some preliminary evidence supporting the use of *Inspiration* as a study strategy for students with learning disabilities. Specifically, they reported that some students became adept at using the software independently and improved their study skills.

Mastropieri, Scruggs, Abdulrahman, and Gardizi (2002) implemented a study in high school world history classes comparing the effects of using spatial organizers created using the *Inspiration* (2000) software and a more traditional teacher-provided instructional approach. In a crossover design, inclusive tenth-grade classes containing students with and without disabilities were taught how to use the software to study world history content. Four regularly assigned teachers co-taught both treatment conditions using the same adopted textbooks and the same chapters. Teachers were trained in how to use the *Inspiration* software and were provided disks containing student and teacher directions as well as templates using the software. Teachers identified several chapters from the adopted textbook and highlighted content that was linked to the state's upcoming high-stakes testing as critical for student learning. Templates were developed using *Inspiration* software that organized the content conceptually from all of the chapters in the study. These templates were reviewed with the teachers and selected as optimal for project use.

In the spatial organization condition, students spent time in the computer lab learning to use the software. For example, students were taught how to open and close files, how to edit organizers, and how to save and print their files. All students were given disks containing the directions and practice templates for learning to use the software. Once the actual unit of instruction began, students were given spatial organizers containing the general outline with blank boxes for the content for their respective chapters. During teachers' presentation of the content in the classroom, students were asked to take notes using their spatial organizers. Instruction proceeded as it always had except for the use of the spatial organizer to assist with taking notes in class. Later, students went to the computer lab, opened their saved templates and inserted the notes from class onto their organizers. Following this, they printed out spatially organized and outline views of the content for studying independently.

In the traditional instruction condition, teachers presented information relevant to the respective chapters, but did not use any spatially organized framework.

Pre- and posttesting indicated that students learned significantly more (about 32% more) world history content when they were allowed to use the spatial organizers that were developed using the *Inspiration* software. Further, most students indicated a strong preference for using the software. Students liked the software, especially the feature that allowed printable formats in outline and organizer views. In fact, several students wanted to obtain copies of the software for home use. During the observations under both instructional conditions, it was noted how easily students appeared to gain facility with the software. Conversely, teachers appeared less comfortable in the computer labs. In fact, teachers requested that the university research team teach the initial use of the software to all students and that they also be present during all computer lab sessions. Not surprisingly, teacher reports on the software were more equivocal. Although they saw the value of the software, they lacked confidence in their own abilities to use all its features and thought they would be less likely to use it as an instructional aid in the future. This demonstrates the need for teachers to feel comfortable with instructional interventions, especially when the use of computer software is a necessary component.

SUMMARY AND CONCLUSIONS

Findings from the present review yielded some promising evidence of best practice at teaching reading comprehension to students with disabilities in middle and secondary schools. At the same time, this review points to many remaining challenges for teachers and researchers alike. Major areas are now discussed.

1. Research evidence indicates that specific interventions help facilitate reading comprehension for secondary-aged students with disabilities. Specific instructional features of these interventions include components of cognitive strategy and direct instruction using guided and independent practice. There appears to be an additive affect between overall research effectiveness and the number of instructional components and features within a single research study (Swanson, 1999b). In other words, the most efficacious treatments appear to have the greatest number of effective components and features during comprehension strategy instruction.

2. Comprehension strategies seen to be effective with younger children with learning disabilities are also effective with adolescents with learning disabilities. This means that teachers and researchers can select reading comprehension strategies that have efficacy data and test them with some assurance at different age and grade levels. This does not imply that the strategies should not be carefully evaluated at new

grade levels. However, it has been documented that when adolescents with disabilities are taught to use reading comprehension strategies, effects are just as large as those observed with younger children with learning disabilities.

3. Instruction of reading comprehension strategies can consume large amounts of class time. Many adolescents with learning disabilities appear to lack comprehension strategies at the start of instruction. For example, it was observed that asking and answering simple questions such as "Who or what is the passage about?," "What is happening to the who or what?," or "What is a summary sentence?" was initially very difficult for many adolescents with learning disabilities. Several studies documented that students with learning disabilities required repetitive, intensive opportunities to practice using strategies before they became proficient. This implies that sufficient time during school must be allocated to reading comprehension strategy instruction for students to succeed.

4. Recent studies have extended what reviews have revealed. Simple comprehension strategies that require students to ask and answer questions about text while they are reading appear to have a profound influence on students who previously appeared to use no comprehension strategies. However, learning to effectively use these strategies is not easy for students with disabilities, especially when combined with difficult-to-read content-area textbooks. Deliberate intensive interaction with the text content appears to make the information more familiar and more memorable for students.

5. Summarization strategies can be combined with peer tutoring across content domains to provide a facilitative effect for reading comprehension. Tutoring interventions appear to improve content-area learning while also improving reading comprehension strategies. These strategies, in turn, exert a facilitative effect on content learning (see also Mastropieri & Scruggs, 2000, 2002).

6. Peer mediation can be used to help facilitate learning of conceptually challenging chemistry content using elaborative strategies. For example, conceptually challenging chemistry content was adapted to formats that could be used during tutoring. It was also seen that elaborative strategies, including mnemonic strategies, could be included within tutoring materials. In addition, use of *Inspiration* software to create spatial organization of academic content resulted in increased learning of world history content.

7. Students with learning disabilities require appropriate strategy instruction to learn academic content. However, the intensity of the instruction is also of great importance. As the Division for Learning Disabilities recently wrote (2002):

> Research indicates that these treatments are effective only when they are implemented accurately, consistently, and intensively. Such implementation is facilitated, in turn, by appropriately high expectations for student performance and by several contextual factors, including reasonable caseloads, lower pupil-teacher ratios, and a general school environment that values instruction and recognizes that ongoing progress monitoring (in contrast to high-stakes testing) is a key indicator of the academic achievement of students with LD. In general, students with LD require intensive, iterative (recursive), explicit instruction to achieve academic success. (p. 2)

Remaining Concerns

Present-day realities in schools present challenges to the delivery of high-quality instruction to secondary students with learning disabilities. Teachers are under pressure to cover content linked to high-stakes testing, and often feel compelled to cover content at an inappropriately rapid pace. Secondary textbooks are challenging for many students with disabilities, and therefore require significant modification and accommodation to be used effectively. Although co-teaching is a popular inclusive strategy, it is not always implemented effectively. The attitude of the general education teacher is critical in implementing effective teaching and learning strategies. Indeed, negative attitudes may inhibit implementation of effective instructional practices even when teachers see that specific strategies increase learning.

Many challenges remain, therefore, in implementing high-quality reading comprehension instruction for students with learning disabilities in secondary schools. Given the rapid pace of instruction, coupled with the inconsiderateness and difficulty levels of textbooks, it is important to uncover additional strategies for facilitating reading comprehension. It is also important that present and emerging strategies be coupled with strategies to improve teacher receptivity to interventions, and to implementing strategies appropriately. In addition, publishers of textbooks could increase efforts to improve the considerateness of textbooks, and to provide more supplemental materials that would be useful for students with reading difficulties. Future research addressing these issues would do much to uncover more optimal procedures for facilitating comprehension for secondary-level students with disabilities.

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