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The Impact of a Strategy-Based Intervention on the Comprehension and Strategy Use of Struggling Adolescent Readers

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This study examines the impact of the Learning Strategies Curriculum (LSC), an adolescent reading intervention program, on 6th- and 9th-grade students' reading comprehension and strategy use. Using a randomized treatment–control group design, the study compared student outcomes for these constructs for 365 students who received daily instruction in 6 LSC strategies and 290 students who did not receive intervention instruction. After 1 school year, 6th-grade students who received intervention instruction significantly outperformed students in the control group on a standardized measure of reading comprehension and reported using problem-solving strategies in reading to a greater extent than students in the control group. There were no significant differences between 9th grade intervention and control groups in reading comprehension or strategy use.

Keywords: adolescent literacy, reading intervention, reading strategy use

Over the past several decades, reading researchers have focused attention on improving the reading comprehension of young students and have emphasized the prevention of reading difficulties at the elementary level (National Reading Panel, 2000; Snow, Burns, & Griffin, 1998). Research findings suggesting that students who do not read well by the end of third grade are likely to experience failure throughout their educational careers (e.g., Juel, 1988) have led to this emphasis on and funding for early literacy programs. These studies and resulting policies have targeted improved classroom instruction and the provision of intervention programs for students who struggle with learning to read in the early grades, but they have not addressed the reading difficulties that persist among adolescent students (ACT, 2006; National Assessment of Educational Progress, 2005).

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The intense and exclusive focus on early literacy policies and practices fails to acknowledge that reading is a complex developmental process in which individuals increase in competence over the lifespan (Alexander, 2005–2006). Competence in reading comprehension is gained as students develop text-based decoding and lexical skills, increase in domain knowledge, topic knowledge, and interest, and develop in cognitive monitoring and strategy use as texts become more complex. While many people move through the phases of reading development to proficient reading without difficulty, others struggle with reading comprehension at one developmental stage or another or in one situational context or another. It is the facile use of reading strategies that enables readers to comprehend when text becomes difficult (Graesser, 2007). Most children begin to use a range of strategies at the end of elementary school or beginning of middle school, particularly strategies that enable them to understand the words and sentences as they are presented in the text (McNamara, Ozuru, Best, & O'Reilly, 2007). However, some adolescents encounter difficulties with reading strategy use and need targeted interventions that specifically include reading strategy instruction (Alvermann, 2001; Biancarosa & Snow, 2004).

Research on the effectiveness of targeted reading interventions for adolescents has shown promise for improving students' comprehension abilities. Slavin, Cheung, Groff, and Lake's (2008) synthesis of effective reading programs for struggling adolescent readers suggested that studies of mixed-method models that include large-group, small-group, and computer-assisted individualized learning had positive effects, as did instructional-process programs that used cooperative learning. The effects of studies of computer assisted instruction and reading strategy programs that did not emphasize cooperative learning were more modest. Slavin et al.'s (2008) findings provide insight into what current research has to say about the contexts that are most fruitful for adolescent literacy. However, despite their exclusive focus on experimental and quasi-experimental studies, Slavin et al.'s synthesis concluded

that more large scale, methodologically rigorous studies that enable causal claims to be made with confidence are needed.

This article describes one such study that sought to strengthen the research base on adolescent literacy interventions and details results from a randomized controlled field trial conducted in a southeastern state. It focuses on the cognitive reading development of struggling adolescents who participated in the Learning Strategies Curriculum (LSC), an intensive supplemental reading intervention program that emphasizes comprehension strategy acquisition (Deshler & Schumaker, 2005). Because developmental theories of reading suggest that younger and older adolescent students are essentially different in terms of their reading development and abilities (Alexander, 2005–2006; Jacobs, 2008), we separately investigated the extent to which the intervention program affected sixth- and ninth-grade students' reading comprehension and strategy use.

Strategic Processing and Strategy-Based Reading Interventions

A focus on strategy development is central to the literature on improving adolescents' reading comprehension (Biancarosa & Snow, 2004; Conley, 2008). The cognitive strategies that make up the LSC, a program designed to develop students' abilities to use multiple strategies flexibly, are among those that have yielded success in strategy-based research (Clark, Deshler, Shumaker, Alley, & Warner, 1984; Lenz & Hughes, 1990; Woodruff, Schumaker, & Deshler, 2002). In particular, the LSC as implemented in this study focuses on developing students' capacities in the processes of word identification, visual imagery, self-questioning, vocabulary, paraphrasing, and sentence writing, and seeks to facilitate comprehension monitoring that enables children to flexibly use these strategic processes to better understand text.

Strategies are cognitive, metacognitive, and behavioral processes that are deliberately and consciously employed as a means of attaining a goal (Almasi, 2003; Graesser, 2007; Hacker, 2004; Paris, Lipson, & Wixson, 1983; Pressley, Borkowski, & Schneider, 1989). Cognitive strategies (e.g., paraphrasing, questioning) and behavioral strategies (e.g., using a dictionary to clarify the meaning of a word) are used to make progress toward the goal, and metacognitive strategies (e.g., comprehension monitoring, rereading) are used to monitor or assess the progress made toward attaining the goal (Flavell, 1979; Garner, 1987). In fostering reading comprehension, it is imperative that instruction focus on preparing readers not simply to use strategies but to become strategic. This means (a) building readers' knowledge base regarding the declarative, procedural, and conditional knowledge associated with particular strategies; (b) teaching readers how to analyze reading tasks so that they can set goals, plan their actions, and select appropriate strategies; (c) building readers' repertoire of strategies so they have access to a variety of strategies to use flexibly to accomplish their goals and overcome any challenges; (d) teaching readers to monitor and regulate their comprehension; and (e) motivating readers to use cognitive and metacognitive strategies (Pressley, Symons, Snyder, & Cariglia-Bull, 1989). In short, teaching readers to become strategic involves teaching students how to be responsive to the shifting demands of the reading context and continually monitor and evaluate one's progress toward the ultimate goal of constructing meaning from the text.

The theoretical framework for this study has three primary components related to students' capacity for strategic reading. The first theoretical notion that frames this study suggests that comprehension processes occur at multiple levels. At one level, a reader must use the visual and informational cues presented in the text to achieve a basic understanding of the text's meaning. At another level, a reader must use background knowledge, emotion, and personal experiences for inferences and elaborations about the text that enable the reader to comprehend the text in deeper and more meaningful ways. This notion is consistent with a construction–integration model of reading comprehension, which characterizes these levels of reading comprehension as *textbase* or *situation* models (Kintsch, 1998; Kintsch & Kintsch, 2005). In a textbase model of reading comprehension, the sequences of idea units in the text along with the complex interrelationships among these ideas form the textbase. A reader constructs a network of these sequences and relationships to form a mental representation of the text to comprehend at one level. However, to achieve deeper levels of comprehension of text, a reader must construct a situation model by integrating the textbase with his or her prior knowledge and experience. Strategies, then, are used during the reading process to help facilitate this integration process (Graesser, 2007). As such, some strategies relate more to constructing the textbase (i.e., decoding word parts, vocabulary retrieval), while others support construction of the situation model (i.e., visualization, self-questioning). Successful reading, then, depends on a reader's ability to monitor his or her construction of meaning and to flexibly use cognitive strategies that support construction–integration (McNamara et al., 2007). As some have acknowledged, even strategies that are often categorized as higher level processes can be acquired and taught along a continuum of complexity (College Board, 2006; McNamara et al., 2007). To construct an effective situation model, readers must possess the procedural and conditional knowledge and application of strategies to go beyond the text through the integration of complex inferences and elaborations.

The strategies comprising the LSC, the intervention evaluated in this study, helped students first develop a textbase for comprehension and then develop the requisite skills for developing a situation model. The decoding and vocabulary strategies presented facilitate students' initial access to the text, while the strategies of paraphrasing, visualizing, and self-questioning provide students with a basis for drawing in their own knowledge and experiences. Because the LSC was designed especially for struggling readers, instruction around the indentified strategies requires students to develop processes at more basic levels along the reading comprehension continuum (College Board, 2006). As struggling adolescent readers become more adept at using these processes, they can then begin to engage in more complex elaborations.

The second theoretical notion that frames this study is that reading comprehension is a developmental process in which readers' abilities to actively process text are formed across the lifespan (Alexander, 2005–2006). Thus, readers at different developmental stages of adolescence may respond to strategy instruction differently, with varying levels of effectiveness. As readers develop over time, they gain increasing control over their own cognitive processing. As readers move out of childhood, they become more facile with word-level skills such as decoding and can provide more attention to deep-level information processing. In late childhood and early adolescence, readers reach higher levels of knowl-

edge about text structures and genres while also heightening their knowledge of topics they encounter in increasingly complex texts (Oakhill & Cain, 2007). As children move into adolescence and progress to middle school, they become more adept at monitoring their cognitive processes while reading (Baker, 1984; Cross & Paris, 1988; Myers & Paris, 1978) and therefore achieve higher levels of metacognition (Flavell, 1979). Older adolescents draw from rich background knowledge and experiences and use higher level strategic processes (Jacobs, 2008). In this study, we characterize adolescence as the period between late elementary school and late high school; early adolescence represents the time period beginning around fourth grade and proceeding through middle school, and later adolescence refers to the high school years (Jacobs, 2008).

Research comparing the reading processes of younger and older readers has identified specific relationships between age and reading processes. Baker and Brown (1984) noted that younger readers lack (a) a complete and consistent knowledge base, (b) organizational skills, and (c) inferential reasoning skills that are essential for successful comprehension monitoring. Prior research has shown that younger readers are less able to recognize incomplete information and fail to recognize problems in their comprehension (Markman, 1977). They are also less likely to monitor their comprehension and use external sources to resolve discrepancies rather than relying on internal strategies such as rereading (Myers & Paris, 1978). As children approach adolescence, word-level processing, domain-specific knowledge, and understanding of text structures increase, making deep-level processing and metacognition more achievable (Cross & Paris, 1988; Oakhill & Cain, 2007).

Strategy-based studies have suggested relationships between students' incoming strategy knowledge and the extent to which they benefit from strategy instruction. McNamara, O'Reilly, Best, and Ozuru (2006) found that electronic strategy-based instruction that was focused on going beyond basic text understanding helped students at lower levels of strategy knowledge develop an effective textbase, while students with more sophisticated strategy knowledge developed higher order comprehension processes. Because age and development relate so closely to the acquisition and use of reading strategies, it is possible that students in earlier phases of adolescence might respond differently to a cognitive strategy-based intervention than in later phases of adolescence. This study examined the impact of reading strategy training on both sixth- and ninth-grade students to test this hypothesis.

The third notion that frames this study is that strategy training consisting of a set of strategies that readers learn to use flexibly, such as those taught as part of the LSC, can help struggling readers develop strategies for constructing a textbase and improve comprehension. Reviews of research (e.g., Almasi, Palmer, Madden, & Hart, in press; Gersten, Fuchs, Williams, & Baker, 2001; Mastropieri, Scruggs, Bakken, & Whedon, 1996; National Reading Panel, 2000; Paris, Wasik, & Turner, 1991; Pearson & Dole, 1987; Pearson & Fielding, 1991; Pressley, 2000; Pressley, Johnson, Symons, McGoldrick, & Kurita, 1989) have identified a number of strategies with sufficient evidence to support their use, including comprehension monitoring, constructing mental images, identifying story grammar components, question generation while reading, and summarization. These short-term interventions were successful in showing that students in treatment conditions outperformed those in control conditions. However, they did not yield long-term results, nor did their use necessarily transfer to varied contexts (Almasi et al., in press; Pressley, 2000). Theoretically, these findings are explained by the fact that most of these "one-shot" strategy instruction interventions did not focus on teaching students to recognize and respond to the conditions that warranted using a particular strategy at a particular time. For example, students were trained to use a particular strategy over several weeks; however, often they were not taught how to recognize when and where they needed to use the strategy and why that particular strategy would enhance comprehension under those circumstances. Students were not taught how to analyze the reading task and the reading context and make adjustments depending on their knowledge of themselves as a reader (i.e., metacognitive knowledge about the task and oneself). Such strategy training did not enable students to learn how to fluidly integrate metacognitive knowledge, metacognitive experiences, and cognitive goals with strategy use.

Thus, researchers began developing interventions that taught readers to flexibly use a variety of strategies as needed by particular texts at particular moments (Almasi et al., in press; National Reading Panel, 2000; Paris et al., 1991; Pressley, 2000). Rather than teachers prompting students to use individual strategies, this instruction required teaching students to become self-regulated learners who were capable of independently determining what strategies to use and when to use them. Strategy-training programs such as reciprocal teaching (Palinscar & Brown, 1984), Informed Strategies from Learning (Paris, Cross, & Lipson, 1984; Paris & Jacobs, 1984; Paris & Oka, 1986), and Transactional Strategies Instruction (Brown, Pressley, Van Meter, & Schuder, 1996; Pressley, El-Dinary, et al., 1992) have proven successful with readers at various age levels, including adolescents. These programs are characterized by comprehensive sets of strategies with instruction focusing on developing the declarative, procedural, and conditional knowledge needed to flexibly use multiple strategies, depending on the context for reading and the problems encountered in the text. These strategy interventions engage students in higher level cognitive interactions that enable students to go beyond the text to construct meaning.

In contrast to earlier approaches that emphasized mastery of lower level and individual strategies, these programs taught students how to analyze the reading task, how to use a set of comprehension strategies flexibly, and how to recognize where, when, and why those strategies should be used. The key theoretical distinction is that the interventions in these studies were composed of cohesive sets of reading strategies focused on developing metacognitive awareness of the task and self and fostered self-initiated and self-regulated strategy use. These studies indicated promise at improving reading comprehension for students with and without reading difficulties in various stages of adolescent development. The study described in this article follows this line of research by examining effects of the LSC on students in sixth and ninth grades.

Description of the Intervention

While the intervention programs described above were developed for students of various ages and ability levels, the LSC was created specifically for struggling adolescent readers. Developed by the University of Kansas Center for Research on Learning (Tralli, Colombo, Deshler, & Schumaker, 1996) as part of the

Strategies Intervention Model (SIM), the LSC is divided into three strands: acquisition, storage, and expression. Each strand includes a number of strategies designed to help students derive information from texts, identify and remember important information, or develop writing or academic competence. Each strategy is taught through eight instructional stages: pretest and commitments, describe, model, verbal practice, controlled practice and feedback, posttest and commitments, and generalization.

The LSC, as implemented in this study, included strategies from all three strands. Students in this study were taught the strategies of word identification, visual imagery, self questioning, paraphrasing, and sentence writing, which have shown positive results in previous research when used with students in Grades 7 through 12. The word identification strategy has been effective in reducing oral reading errors (Lenz & Hughes, 1990) and helping ninth graders make significant gains in reading level (Woodruff et al., 2002). Combining the visual imagery and self-questioning strategies was found to improve students' comprehension of grade-level materials (Clark et al., 1984). The paraphrasing strategy has been effective at enhancing paraphrasing skills, reading comprehension, and reading rate (Lee & Von Colln, 2003), and has helped students recall information while reading (Schumaker & Deshler, 1992). Beals (1983) found similar positive results when the paraphrasing strategy was taught in combination with self-questioning.

In addition to these strategies from the acquisition strand, students were taught strategies from the storage and expression strands of the LSC. From the storage strand, students were taught the LINCS vocabulary strategy, which involves using a mnemonic to memorize word meanings. This vocabulary strategy has yielded positive results in research studies measuring vocabulary acquisition (Wedel, Deshler, Schumaker, & Ellis, as reported in Ellis, 1992; Harris, as cited in Schumaker & Deshler, 2006). From the expression strand, students were taught sentence writing, which has demonstrated improved sentence writing (Kline, Schumaker, & Deshler, 1991) in previous research.

Although a number of research studies have examined the effectiveness of various components of the LSC and have yielded favorable results, these studies were burdened with methodological limitations such as small sample size and inadequate measures (Lidgus & Vassos, 1996; Reuter & Erickson, 1995; Tralli et al., 1996). Like the single strategy studies of the 1980s, these studies also examined individual strategies that make up the LSC rather than examining the impact of instruction in multiple strategies. In addition, much of the LSC research has been conducted exclusively with students in special education. The present study expands this research base by examining the effect of teaching a comprehensive set of strategies in the LSC on both sixth- and ninth-grade students' reading comprehension. In addition, this study provides insight into the impact of the LSC on students' strategy use.

Method

Context of the Study

During the fall of 2006, this study was implemented as part of the federal Striving Readers initiative in 12 middle and 11 high schools across a rural state. This initiative had two primary components: (a) a whole-school model that involved professional development for all content teachers in content area literacy and (b) a targeted intervention (LSC) for sixth- and ninth-grade students who scored the equivalent of two grade levels below grade level on the study pretest, the Group Reading and Diagnostic Evaluation (GRADE). All students were provided the whole-school model, but only a randomly selected group of struggling readers received the targeted intervention. While we expected that students in both the targeted intervention treatment and control groups would benefit similarly from the whole-school model, the randomized–controlled research design enabled us to ascertain the effectiveness of the targeted intervention over and above the whole-school model. The LSC was a supplement to the regular curriculum wherein students in the targeted intervention received the regular language arts curriculum plus an extra 50–60 min of the LSC per day over the course of the school year.

During the year of the project, 24 teachers received intervention training from a certified LSC professional development specialist. During this professional development, teachers were trained to teach six strategies of the LSC: word identification, visual imagery, self-questioning, LINCS vocabulary strategy, sentence writing, and paraphrasing (see Appendix A for a description of each strategy). These strategies were selected for focus because, as a group, they represented each strand of the model (acquisition, storage, and expression) and gave students tools for word recognition, comprehension, vocabulary, and writing. Teachers received this training over 2.5 days during the summer prior to the school year and 6 half-day sessions across the school year. During the summer professional development period prior to the start of school, teachers were taught the word identification and self-questioning strategies. During December, they were taught visual imagery and LINCS vocabulary, and in January and February, they were taught to implement sentence writing. Finally, in April they learned to teach paraphrasing.

Each strategy of the LSC had a corresponding instructional manual giving detailed instructions for how to teach it and document student progress. Each manual included eight critical instructional procedures common across the strategies: pretest and make commitments, describe, model, verbal practice, controlled practice and feedback, advanced practice and feedback, posttest and make commitments, and generalization. Manuals provided teachers with language and ideas for engaging students in activities around each instructional stage.

Before each strategy was introduced for the first time, students took a pretest in which they read from grade-level passages and performed tasks related to the strategy. For example, for the visual imagery strategy students read three paragraphs of text and described their mental images. The word identification strategy manual included a prefix and suffix pretest in which students took a written quiz. Once students completed the pretest, they received feedback from the teacher on their initial performance. Students often marked their initial score on a progress tracking chart for each strategy. Then they made a verbal commitment to improve their skills, while the teacher made a verbal commitment to the students to help them accomplish this. For example, a student's commitment might be, "I commit to learning how to find the meaning of unknown words by using the LINCS vocabulary strategy," while the teacher's commitment might be, "I commit to helping you learn to use the LINCS vocabulary strategy to find the

meaning of unknown words by showing you how to use the strategy and then helping you practice it."

In the describe and model stages, the teacher provided explicit instruction and demonstrations related to the strategy. Teachers explained the purpose of the strategy, reviewed the advantages of using it, and described each stage of the strategy. For instance, for the word identification strategy, the teacher showed students the acronym denoting each stage of the strategy (DISSECT) and identified the process that each letter represented (see Appendix A for the acronyms and steps of each strategy). Then, the teacher demonstrated how to use the strategy by thinking aloud as he or she worked through each step. For example, to show students how to use the word identification strategy, a teacher might display a short passage on the overhead projector and demonstrate how to use each step of the strategy to decode a difficult word in the passage. Teachers often modeled the strategy multiple times to show the students when to use the strategy and how to use it effectively.

The next stages of instruction involved engaging students in practicing the strategy in both isolated and contextualized ways. During the verbal practice stage, the teacher guided the students in learning to explain and name each step of the strategy through repeated practice. Instruction for this stage typically involved the students making and studying flash cards of the different steps of the strategy, individually and in pairs or groups. During the controlled practice and feedback stage, the students practiced using the strategy with materials at their instructional level. For this stage, teachers typically gave students a passage and directed them to find a place where they needed to use the strategy to comprehend the text. Then, teachers guided students in implementing the strategy and provided them with feedback. For example, to teach the word identification strategy in the controlled practice stage, teachers might give students a passage and instruct them to find unknown words. Then, they would guide the students in each stage of the strategy, starting with "Discover the sounds and context," which involved having the students read the sentence containing the word and using the letters of the word to try to figure out some of the letter sounds. Teachers provided feedback by monitoring each student's use of the strategy and providing them with praise and support as needed. In the advanced practice and feedback stage, students progressed to practicing the strategy with grade-level texts rather than texts at their instructional levels.

In the final instructional stages, the focus was on assessing students' strategy use and facilitating strategy use across contexts. During the posttest and make commitments stage, students took a posttest and made a commitment to use the strategy in other settings. Students also often charted their progress from pretest to posttest. In the generalization stage, students were guided through instruction designed to help them use the strategy in other settings. This phase of instruction focused on making students aware of contexts in which they could use their new strategy, provided them with opportunities to practice and adapt the strategy in a variety of contexts, and encouraged them to evaluate their use of the strategy. In the generalization stage, the teachers and students identified how and when the strategy might be used in their content classes and engaged in periodic reflections on students' use of the strategy across classes and contexts.

Although each strategy was taught sequentially, teachers continually reviewed previously taught strategies and encouraged students to apply strategies flexibly during practice stages. Lessons often included explicit focus on integrating two or more strategies. For instance, while students were reading their self-selected texts during silent reading time, they were instructed to find an unknown word and use the word identification strategy as well as the visual imagery strategy. In addition, teachers scaffolded students' flexible use by prompting them to use the appropriate strategies when problems arose during reading.

The strategies were introduced sequentially according to the professional development schedule that spanned the school year. Teachers were expected to implement each strategy according to the eight critical instructional procedures and instructions detailed in the manuals; however, the amount of time devoted to each stage and strategy differed from classroom to classroom. Teachers were expected to cater to the needs of their students and were encouraged to use their professional judgment and evidence from their own documentation of student progress to determine the length of time spent on each stage and strategy. The texts used to teach the strategies also differed from classroom to classroom, in that teachers were encouraged to select their own texts to fit the needs of their students. Teachers used both instructional-level and grade-level texts, including novels, newspapers, textbooks, content area trade books, plays, magazines, and a variety of book series. Students engaged in some written activities to reinforce their strategy knowledge but did not compose extended texts.

Consistent with research and recommendations on multiple strategy instruction (Brown et al., 1996; Palinscar & Brown, 1984; Pressley, El-Dinary, et al., 1992; Rosenshine & Meister, 1994), students were encouraged to integrate the strategies once they were introduced with strategies they had previously learned. Thus, this study did not set out to determine the effectiveness of the individual strategies that make up the LSC; instead, it set out to ascertain the impact of the set of strategies as a whole.

Research Design

The overarching purpose of the study was to examine the impact of the LSC on adolescent struggling readers' reading comprehension. Because we hypothesized that younger and older adolescent students might respond to the intervention differently, we separately investigated the extent to which the intervention program benefited sixth- and ninth-grade students. In addition, we examined the impact of the LSC on both sixth- and ninth-grade struggling readers' reading strategy use. To answer our research questions, we used a randomized treatment–control, pretest–posttest design in the 12 middle and 11 high schools. Students in the targeted intervention received the LSC, and students in the control group engaged in "business as usual" (i.e., the regular language arts curriculum and an elective such as band or civics).

Participants

Participants in this study were selected on the basis of their performance on the GRADE in the fall of the school year. Sixth- and ninth-grade students who scored the equivalent of two grade levels or more below grade level on the assessment in the fall were randomly selected for intervention treatment and control.

Sample selection process. A within-school iterative random sampling process was used to place eligible students in treatment

and control. To maximize power and to ensure the intervention and control groups were as similar as possible for all the demographic variables collected, we stratified the sample on four demographic variables: special education status, free or reduced-price lunch status, ethnicity, and gender. Average normal curve equivalent (NCE) scores for the two groups were then compared; if average NCEs were more than two NCEs different, students were randomly selected from affected strata until the average NCE scores of treatment and control were highly comparable. This process was repeated until treatment and control were equivalent in terms of achievement scores and in terms of each of the four strata variables.

Description of participants. The participants for this study included 25 teachers and 862 students in 23 schools. At the end of the study, 655 students had both pre- and posttests and thus made up the final sample of participants. Table 1 provides demographic information for the 23 schools and illustrates that the student population in these schools was primarily Caucasian with relatively high percentages of students living in poverty, where poverty is measured by the percentage of students qualifying for free and reduced-price lunch services. Twelve middle school teachers (all female and Caucasian) and 14 high school teachers (13 female, one male, all Caucasian) provided LSC intervention instruction to students in the treatment groups.

Within the 12 middle schools, 192 sixth graders were intended for treatment and 166 were intended for the control group (see Table 2). Eleven middle school parents (5.7%) opted out of permitting their child to receive the intervention. Attrition due to transfer was comparable in both intervention and control conditions; however, more sixth graders in the control condition withdrew ($n = 35$) than in the intervention condition ($n = 21$). By the end of the year, 302 sixth graders (171 intervention and 131 control students) had complete pretest and posttest scores on the standardized test.

Among ninth graders, 254 were intended to be treated and 232 were intended for the control group (see Table 2). Thirty-five high school parents (8.7%) opted out of permitting their child to receive the intervention. Attrition due to transfer and withdrawal from school was similar in both intervention and control conditions; however, more ninth graders in the control condition withdrew ($n = 73$) than in the intervention condition ($n = 60$). By the end of the year, 353 ninth graders (194 intervention and 159 control students) had complete pretest and posttest scores on the standardized test.

Demographics of students in the intervention and control conditions with outcome data were similar for both sixth and ninth graders in terms of gender, ethnicity, and socioeconomic status. The sample consisted of more boys than girls (see Table 3). In terms of ethnicity, nearly 90% of students in the sample were Caucasian and approximately 6% of the students were African American. More than half of the students in the sample received free or reduced-price lunch. In both sixth and ninth grades, the intervention conditions included larger proportions of students receiving special education reading and writing services than the control conditions, and the control conditions included larger proportions of students who were not in special education than the intervention conditions.

Intervention teacher characteristics. As part of this study, each school hired a literacy teacher who spent half of the school day teaching the targeted intervention classes; the other half of each school day was spent working with other teachers. Each school employed one intervention teacher, with the exception of three larger high schools that employed two ninth-grade intervention teachers. Of the 24 intervention teachers originally hired, one sixth-grade teacher resigned and was replaced midyear, for a total of 25 intervention teachers in all. Twelve of the intervention teachers taught only ninth grade, 11 of the teachers taught only sixth grade, and two of the intervention teachers taught both sixth and ninth grades in small, combined middle and high schools serving Grades 6 through 12. All of the intervention teachers were female Caucasians, except for one Caucasian male ninth-grade teacher.

Table 4 shows the teachers' level of experience, education, and content area expertise. The sixth-grade teachers had more years of experience than the ninth-grade teachers. In addition, sixth-grade teachers had higher levels of education than ninth-grade teachers and included more teachers with certification in teaching reading. Five of the sixth-grade teachers had certification in reading, and two had a background in elementary education; one of the ninth-grade teachers had certification in reading, and two had a background in elementary education.

Measures and Data Collection

This study used measures of reading achievement and strategy use to ascertain the impact of the LSC on student outcomes. A correlation matrix of all variables for intervention and control groups is presented in Appendix B. In addition, the study used observations of intervention instruction to determine treatment fidelity.

GRADE. The GRADE is a norm-referenced, standardized test of reading achievement that yields standard NCE scores and scale scores labeled Growth Scale Value (GSV) scores. The GRADE components and subtests for sixth and ninth grades include vocabulary, sentence comprehension, passage comprehension, and listening comprehension (Williams, 2001). Word-level skills are not

Table 1
School Demographics

		% of students		
Schools	% of schools Title I	Free or reduced-price lunch	Caucasian	African American
Middle ($n = 12$)	72	52.6	91.1	4.5
High ($n = 11$)	10	45.6	89.9	5.7

Table 2
Intervention and Control Classrooms

Grade and group	Number			Mean no. of students per school
	Students intended to treat	Attrition	Students actually treated	
6th				
Intervention	192	21	171	16.0
Control	166	35	131	13.8
9th				
Intervention	254	60	194	23.1
Control	232	73	159	21.1
Total				
Intervention	446	81	365	19.3
Control	398	108	290	17.3

measured on the GRADE. Fugate and Waterman (2004) found the GRADE's reliability adequate for educational decision making. Reliability coefficients across test levels, test forms, and subject grade levels are consistently .90 or better for the total test score, including subtests of vocabulary, sentence comprehension, and passage comprehension. Alternate forms reliability ranged from .81 to .93, while test–retest reliability coefficients ranged from .88 to .93. In this study, both GSV and NCE scores are provided. The GRADE technical manual (Williams, 2001) shows the NCE distribution to be identical to the standard scores distribution. Further, the manual states that while NCEs are based on percentiles, they have been converted to an equal-interval scale, making arithmetical manipulation appropriate.

All sixth- and ninth-grade students in the 23 Striving Readers schools took the GRADE assessment (Form A) during the first 2 weeks of the 2006–2007 school year. Consistent with GRADE norming procedures, the GRADE was administered in classrooms by teachers. Prior to September 1, 2006, schools administered make-up tests to any sixth or ninth grader who missed the first administration. In the spring, students took the GRADE assessment (Form B) during the weeks of April 30–May 11, 2007. In both the fall and the spring, school intervention teachers gathered students' GRADE answer sheets and mailed or delivered them to our offices. Research assistants scanned the answer sheets for scoring.

Metacognitive Awareness of Reading Strategies Inventory (MARSI). The MARSI is a self-report measure designed specifically to assess middle and high school students' perceived use of reading strategies during academic reading (Mokhtari & Reichard, 2002). The MARSI includes items related to three strategy domains: global reading, problem-solving, and support strategies. Global reading strategies represent a set of reading strategies oriented toward a global analysis of text. Problem-solving strategies include items oriented around strategies for solving problems when the text becomes difficult to read. Support reading strategies involve use of outside reference materials, note taking, and other functional or support strategies. The survey items are presented on a Likert scale of 1–5 (1 = *I never or almost never do this* and 5 = *I always or almost always do this*). This measure has been reported to have high reliability. Mokhtari and Reichard (2002) reported a Cronbach's alpha coefficient of .93 for the entire scale. In the current study, we report a Cronbach's alpha coefficient for fall and

Table 3
Intervention and Control Student Demographics (and Proportions)

Characteristic	6th grade				9th grade				Total	
	Intervention (n = 171)		Control (n = 131)		Intervention (n = 194)		Control (n = 159)			
Gender										
Male	100	(.58)	73	(.56)	119	(.61)	95	(.60)	387	(.59)
Female	71	(.42)	58	(.44)	75	(.39)	64	(.40)	268	(.41)
Ethnicity										
Caucasian	156	(.91)	116	(.89)	173	(.89)	139	(.87)	584	(.89)
African American	8	(.05)	7	(.05)	9	(.05)	13	(.08)	37	(.06)
Other	7	(.04)	8	(.06)	12	(.06)	7	(.04)	34	(.05)
Lunch										
Pays	80	(.47)	57	(.44)	84	(.43)	71	(.45)	292	(.45)
Free/reduced-price	91	(.53)	74	(.56)	110	(.57)	88	(.55)	363	(.55)
Special education										
Not in	118	(.69)	101	(.77)	122	(.63)	119	(.75)	460	(.70)
Reading/writing	39	(.23)	23	(.18)	49	(.25)	23	(.15)	134	(.20)
LEP, EBD, Comb	14	(.08)	7	(.05)	23	(.12)	17	(.11)	61	(.10)

Note. LEP = limited English proficiency; EBD = emotional-behavior disability; Comb = combination of designs.

Table 4
Demographics of Intervention Teachers

Characteristic	Grade taught			
	6th (n = 11)	9th (n = 12)	6th & 9th (n = 2)	Total (N = 25)
Mean years' experience (*SD*)	13.56[a] (7.49)	9.27[b] (4.73)	19.00 (5.66)	11.91 (6.57)
Certification				
Reading	5	1	0	6
English	5	4	1	8
Social studies	1	5	1	7
Elementary education	2	2	0	4
Highest degree earned				
BA	0	3	0	3
MA	8	8	2	18
MA + 30 hr	3	1	0	4

Note. Intervention teachers who stayed in the position for less than half a semester are not included in these statistics.
[a] n = 9. There are missing data for two intervention teachers. [b] n = 11. There is missing data for one intervention teacher.

spring of .84 and .86 (13 items) for the global subscale, .80 and .82 (nine items) for the support subscale, and .81 and .83 (eight items) for the problem-solving subscale. The MARSI items are shown in Appendix C and are categorized according to subscale. Students took the MARSI during the fall and spring of the 2006–2007 school year. Research assistants administered and collected the student surveys during the weeks of September 1–October 30 in fall and during the weeks of May 14–June 1 in spring.

Because the MARSI is a student self-report measure that is subject to standard problems associated with self-report scales (Hadwin, Winne, Stockley, Nesit, & Woszczyna, 2001), "think-alouds" were conducted as a secondary data source to confirm or disconfirm the MARSI results. Passages and procedures from the Qualitative Reading Inventory–4 (QRI; Leslie & Caldwell, 2006) were used to elicit responses from students about what they were thinking as they read the selected passages. Consent forms were sent home with students in two teachers' classes in each school: the intervention teacher and a randomly selected English teacher. This was done to determine whether there was bias in the degree to which think-aloud data and self-report data from the MARSI matched among students from different treatment conditions. Ninety-five intervention and 12 control students returned consent forms. From that pool, students were randomly selected to participate in the think-alouds; of that random sample, 17 intervention and seven control students both completed the think-alouds and had completed the MARSI for this analysis.

To enable struggling readers to participate meaningfully, examiners asked sixth graders to read a fourth-grade passage and ninth graders to read a sixth-grade passage from the QRI. Consistent with QRI procedures, the passages were marked with stops in six designated places in the text. At those points in the text, students were asked to tell the examiner what they were thinking. The examiner then wrote down the students' responses verbatim.

To analyze the think-alouds, Susan Chambers Cantrell and Janice F. Almasi coded each student response according to the MARSI strategy that it represented. For example, a response of "I saw a show about that just the other day," was coded as the MARSI strategy "I think about what I know to help me understand my reading." To establish coding agreement, the two coders independently coded 10 think-aloud protocols and compared their codes (86.3% agreement). The disagreements were discussed and the coders came to 100% consensus. Then, the coders divided the remaining protocols and coded them individually. Of the 30 reading strategies included on the MARSI, 14 were visibly used by students (see Appendix C) when we asked students what they were thinking at the designated stops. Most of the remaining strategies, including a high proportion of problem-solving strategies, were considered invisible, in that students would not have been likely to express that they used the strategies when asked what they were thinking (i.e., "I adjust my reading speed."). As noted in Appendix C, five of the 14 strategies that were used were observed frequently during the think-alouds (at least 10 times each). For these five strategies, enough data existed to provide some insight into the extent to which students' actual use of reading strategies matched their MARSI responses.

If a student selected 1 (*never use*) on the MARSI for a strategy, we expected that he or she would not use this strategy during the think-aloud. Similarly, if a student scored a 5 (*always use*) on the MARSI for a strategy, we expected that the student would use this strategy during the think-aloud passage. Each instance in which students' MARSI response did not match their think-aloud in this way was considered a contradiction between the self-report and students' actual strategy use. Thus, for the five strategies, each student had five opportunities to achieve a match or a contradiction (85 opportunities for the intervention group and 35 opportunities for the control group). Of the 85 opportunities for the *never use* contradiction for intervention students, three (4%) contradictions were noted in which students said they never use a strategy on the MARSI but did in fact exhibit use of the strategy on the think-aloud. Of the 35 opportunities for contradiction for control students, two (6%) *never use* contradictions were noted.

A similar analysis was conducted on the five strategies to see if students erroneously indicated that they always used a strategy. It was considered a contradiction if a student marked a 5 (*always use*) on the MARSI but did not use the strategy on the think-aloud. Of the 85 opportunities for contradiction for intervention students, three (5%) contradictions were noted for *always use*. Of the 35

opportunities for contradiction for control group students, four (11%) contradictions were noted.

Thus, the MARSI represented students' self-reported strategy use relatively well when considering self-report data at the extremes of the Likert scale. While the think-aloud did not serve as a variable in this study, it did validate our use of the MARSI.

Classroom observations. Classroom observations of intervention instruction were conducted to determine treatment fidelity. In the fall of 2006, research assistants attended a training session conducted by the intervention trainer in which they learned to recognize the six LSC strategies and eight stages of the LSC intervention (pretest/commitments, describe, model, verbal practice, controlled practice with feedback, advanced practice, posttest and make commitments, generalization). As part of this training, they identified activities associated with each component.

The investigators then met with the research assistants to provide training related to taking field notes. Training consisted of lecture related to taking field notes, watching video segments, practice taking field notes, and critique. Sample field notes were shared, critiqued, and refined, and four data codes were developed to characterize the range of instructional behaviors observed in the intervention classrooms. The codes were: (a) LSC, (b) other literacy activities, (c) nonliteracy activities, and (d) behavior management. In November 2006, research assistants went out in pairs and practiced taking field notes in three intervention classrooms.

During the spring of 2007, all intervention teachers were observed for at least one class period on two different occasions (n = 47 total observations). The teachers were notified when the observations would occur. The purpose of these observations was twofold: (a) to determine treatment fidelity and (b) to determine the extent to which teachers implemented aspects of the LSC in their instruction. Observers were trained to take field notes at 5-min intervals during the observation to capture the nature of instruction throughout the entire lesson.

Three members of the evaluation team sought interrater reliability for coding the observation protocols. First, the two coprincipal investigators established interrater reliability using 10.5% of the data (n = 4 observations). Interrater reliability was 89.8%. Then the coprincipal investigators trained one research assistant to code the intervention observations in a similar manner. An additional five observations were used to establish reliability among the three coders (13.2% of total data). Interrater reliability was 84% among all three coders. The research assistant then coded all remaining intervention observations (n = 38). These 38 observations formed the corpus of data that was initially analyzed to determine treatment fidelity. However, the second observations were conducted during the very last weeks of the school year, and field notes indicated that for much of the time, teachers and students were engaged in end-of-year activities rather than LSC activities. Thus, the second round of observations was eventually dropped from the analysis.

Teacher interviews. A structured interview with each teacher (n = 47 interviews) served as a secondary data source that was used to gain information to (a) understand the goals of the lesson observed, (b) reconstruct details of the lesson from the teacher's perspective, and (c) enable participants to reflect on the lesson and their training to implement the intervention. Data from the interviews were only used to clarify each teacher's implementation of the intervention. Sample interview questions included: (a) "Tell me about the lesson today"; (b) "What was your goal in instruction today?"; (c) "How does today's lesson fit into your plans for the week (past and future lessons)?" Data from the interviews were not formally analyzed but were read to inform the observation coding process.

Intervention Implementation

Treatment fidelity. The LSC is intended to be implemented a minimum of 50 min daily or at least 250 min each week. Because of scheduling constraints, the number of minutes in each class period ranged from 45 to 90 min. However, teachers were instructed to use the LSC for no more than 60 min per day, and any additional class time was to be spent on activities unrelated to the LSC. Classes that met less than 250 min per week made up the time by conducting the LSC class additional times each month. Thus, no student received LSC instruction for less than 250 min or more than 300 min each week.

To compute treatment fidelity, we determined the proportion of time during each observation that was spent on the LSC in relation to the 50-min minimum. That is, for classes less than 50 min, fidelity to the LSC was determined by dividing the number of actual minutes engaged in teaching the LSC by the total number of class minutes. For classes greater than 50 min, fidelity to the LSC was determined by dividing the number of actual minutes engaged in teaching the LSC by 50 min. This result denotes the percentage of class time that teachers taught the LSC strategies or that students spent practicing the LSC strategies.

The overall mean fidelity to the LSC for both sixth- and ninth-grade intervention teachers was 76.0% (N = 20), meaning that sixth- and ninth-grade intervention teachers spent over three fourths of the 50- to 60-min intervention class time focused on the LSC strategies. The remaining 24% of class time was spent on other literacy or nonliteracy activities. Fidelity ranged from 20% of time (during one observation) to 100% of time (during six observations), with an overall median of 85%. Mean fidelity to the LSC for sixth-grade intervention teachers (65.1% of time) was less than the mean fidelity for ninth-grade intervention teachers (81.5% of time). Fidelity for sixth-grade intervention teachers ranged from 36% of time to 100% of time, with a median of 60% of time. Across all observations, only one sixth-grade teacher had 36% fidelity, whereas one teacher had 100% fidelity. Fidelity for ninth-grade intervention teachers also ranged from 20% to 100% of class time, with a median of 90%. One ninth-grade teacher had 20% fidelity, and five had 100% fidelity.

Because of school scheduling constraints, intervention class period times varied, ranging from 45 to 90 min, but with a maximum of 60 min spent on LSC. Therefore, we conducted an analysis to ascertain whether these differences in class time alone across classes had an impact on students' reading gains. Pearson product-moment correlations indicated that there was no significant relationship between student gains in reading and class time for either sixth or ninth grades. The correlation between sixth-grade students' gains and intervention class time was –.067 (p = .854), and the correlation between ninth-grade students' gains and intervention class time was .232 (p = .519). Thus, we determined that the variation in class time, which involved activities unrelated to LSC, was not a confounding variable, given that teachers did not spend more than 60 min on the LSC.

Data Analysis

Analytic model. Hierarchical linear models (HLMs) were used to estimate the impact of the LSC on reading comprehension and reading strategies outcomes. GSVs and NCEs were used for the GRADE to estimate the impact of the targeted intervention on achievement. Dependent variables for the MARSI included three strategy subscales: Global, Problem-Solving, and Support. A two-level HLM model (students assigned to intervention and control groups within schools) was used to determine the impact of the targeted intervention. This model fit perfectly, with the exception of three large high schools that each had two intervention teachers. A three-level HLM was not used because (a) all middle schools and eight of the 11 high schools had only one intervention teacher; (b) at the three large high schools, the intervention teachers at two schools jointly taught a class; (c) the control students were not similarly nested; and (d) *t* tests revealed no significant differences between students taught by the intervention teachers at the three large high schools.

The HLM model assessed the impact of the targeted intervention on student achievement, or the spring GRADE scores. This same model was used to analyze the spring outcomes for the MARSI. The student variables include the spring GRADE scores as a function of the student's fall GRADE score centered at the school mean, whether a student was in the intervention, and four demographic variables: gender, ethnicity, free or reduced-price lunch status, and special education.

Level 1 Model: Student Achievement—Student Level

$$Y_{ij} = \beta_{0j} + \beta_{1j}\,(Y^{*}_{ij}) + \beta_{2j}\,(T_{ij}) + \sum_{m=3}^{M} \beta_{mj}\alpha_{mij} + \varepsilon_{ij},$$

where Y_{ij} is the spring GRADE (posttest) score for student i at school j; β_{0j} is the mean posttest score for control students at school j; Y^{*}_{ij} is the fall GRADE score for student i centered at school j; β_{1j} is the average GRADE pretest slope for students at school j; $T_{ij} = 1$ if student i is assigned to target intervention at school j, and 0 if control; β_{2j} is the mean difference of pre–post gain between intervention and control students at school j; α_{mij} are additional covariates representing demographic characteristics of student i at school j (gender, ethnicity, free or reduced-price lunch, and special education); β_{mj} are coefficients corresponding to school-level demographic covariates centered at the grand mean; and ε_{ij} is the random effect representing the difference between student ij's score and the predicted mean score for school j. These residual effects are assumed normally distributed with mean 0 and variance σ_2.

Level 2 Model: Student Achievement—School Level

The school-level variables are: Title I designation, 2006–2007, percentage of students qualifying for free or reduced-price lunch, percentage of Caucasian students in the school, and percentage of African American students. With the exception of Title I designation, the school-level variables are centered at the grand mean.

$$\beta_{0j} = \gamma_{00} + \sum_{q}^{Q} \gamma_{oq} W_{qj} + \mu_{0j},$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{mj} = \gamma_{m0},$$

where γ_{00} is the mean posttest score of sixth-grade control students in Kentucky Striving Readers middle schools (or ninth grade in high schools); W_{qj} are four school-level covariates (including Title I designation, percentage of free or reduced-price lunch, percentage of Caucasian students, and percentage of African American students centered at grand mean); γ_{oq} are coefficients corresponding to school-level covariates; μ_{0j} is the unique effect of school j on mean achievement, holding W_{qj} constant (or conditioning on W_{qj}), which is assumed to be normally distributed with mean 0 and variance τ^2; γ_{10} is the average pretest outcome slope; γ_{20} is the overall target intervention treatment effect on posttest GRADE scores; and γ_{m0} is the fixed *m*th school covariate effect on achievement.

Selection of covariates. A number of variables were included or tested for inclusion as covariates in the experimental impact models: baseline GRADE scale score (and equivalently, baseline MARSI subscale scores for strategy use models), gender, ethnicity, special education status, and free or reduced-price lunch status. Decisions about inclusion of the variables as covariates were made on the basis of a $p < .20$ criterion.

Results

Outcomes for Student Reading Achievement

The purpose of this study was to investigate the impact of the LSC on adolescents' reading comprehension. Because we hypothesized that younger and older adolescents might respond to basic strategy instruction differently, we examined reading comprehension outcomes for both sixth- and ninth-grade students.

Equivalence of groups. Independent samples *t* tests were used to evaluate the null hypothesis that intervention students' pretest scores did not differ significantly from control students' pretest scores on the GRADE measure. Results confirmed the null hypothesis for both sixth-grade GRADE pretest in terms of NCE, $t(300) = -1.302$, $p \leq .194$, two-tailed, and GSV, $t(300) = -1.013$, $p \leq .312$, two-tailed; and for ninth-grade GRADE pretest NCE, $t(351) = -1.403$, $p \leq .162$, two-tailed, and GSV, $t(351) = -1.518$, $p \leq .130$, two-tailed.

Impacts for sixth grade. Table 5 indicates the overall impact of the targeted intervention on reading comprehension. For the sixth-grade spring GRADE NCEs, the unadjusted means for the treatment and control groups are 31.0 and 29.8, respectively. However, the estimate of the HLM-adjusted means for spring NCEs is 30.0 for treatment and 27.2 for control. This indicates an estimated impact of 2.76. Sixth-grade students in the targeted intervention significantly outperformed sixth-grade students in the control group ($p = .034$), although the effect size is small (0.218). Results are similar for sixth-grade GSVs, with an effect size of 0.215 and a *p* value of 0.037.

Table D1 in Appendix D shows a summary of model results when significant variables were used as covariates for sixth-grade students. The only significant school-level variable is the propor-

Table 5
Overall Impact of the Target Intervention on Reading Comprehension

	Unadjusted *M*		HLM-adjusted *M*				
Posttest variable	Control[a]	Treatment[b]	Control[a]	Treatment[b]	Estimated impact	Effect size	*p*
6th grade NCE	29.8	31.0	27.2	30.0	2.76	0.218	.034
6th grade GSV	439.5	441.3	435.8	439.7	3.94	0.215	.037
9th grade NCE	32.7	32.7	31.0	32.1	1.09	0.076	.444
9th grade GSV	465.0	465.4	462.98	464.6	1.78	0.096	.320

Note. The number of schools for sixth grade is 12. The number of schools for ninth grade is 11. HLM = hierarchical linear model; NCE = normal curve equivalent; GSV = growth scale value.
[a] Sixth grade $n = 131$, ninth grade $n = 159$. [b] Sixth grade $n = 171$, ninth grade $n = 194$.

tion of students receiving free or reduced lunches. The two significant student-level variables include the individual student's fall GRADE score and the student's special education status (i.e., not in special education, in special education for reading or writing, or in special education for some other reason). For sixth-grade students, participation in the intervention is also significant.

A spring NCE estimate of 24.7287 is derived for a sixth-grade student who attended a middle school with an average percentage of free or reduced-price lunches, was in the control group, was in special education for reasons other than reading and writing, and had fall NCE scores at the school average. The estimate decreases by 0.3221 for every percentage point of increase in the school percentage of free or reduced-price lunches. This means that school-level socioeconomic status (SES) does appear to influence the outcomes. The estimated NCE score for a student at a school with lower SES is slightly lower than the estimate for a student at a school with higher SES. An individual student's spring NCE score estimate increases by 0.7190 for every unit increase in his or her fall NCE score. If a student was in the intervention group, the estimate increases by 2.7551. This indicates that the intervention had a statistically significant positive effect for sixth grade. Special education status is also a significant variable in influencing the spring outcome; students who were not in special education achieved higher outcomes than students who were in special education. If a student was not in special education, the estimate increases by 5.2058. If the student was in special education for reading and writing, the estimate increases by 2.2202, but the difference is not statistically significant from students with other special education designations. There is no evidence of an unexplained difference among schools, with an intraclass correlation (ICC) of .0693. Results for GSVs were similar and are presented in Appendix D, Table D2.

Impacts for ninth grade. Table 5 shows the overall impact of the targeted intervention on ninth graders' reading comprehension. For ninth-grade spring GRADE NCEs, the unadjusted means for the treatment and control groups are 32.7 for treatment and 32.7 for control. The estimated HLM-adjusted means for spring NCEs are 31.0 for treatment and 32.1 for control.

This indicates no significant differences in spring NCEs for treatment and control (estimated impact 1.09, $p = .44$). Results are similar for ninth-grade GSVs, with an effect size of 0.096, and a p value of .320.

Table D3 in Appendix D shows a summary of model results when the same variables included in the middle school model were used as covariates for high school students. Again, for ninth grade, the only significant school-level variable is the proportion of students receiving free or reduced-price lunches. The only significant student-level variable is the individual student's fall GRADE score. Special education status and student's participation in the intervention are not significant.

The spring NCE estimate is 29.6084 for a ninth-grade student who attended a high school with an average percentage of free or reduced-price lunch population, was in the control group, was in special education for reasons other than reading and writing, and had fall NCE scores at his or her school average. The estimate decreases by 0.2103 for every percentage point greater than the schools' average free or reduced-price lunch percentage. This means that, like sixth grade, school-level SES influences student NCE outcomes for ninth grade; students in schools with lower SES scored slightly lower than students in schools with higher SES. An individual student's spring NCE score estimate increases by 0.6897 for every unit increase in his or her fall NCE score. If a student was in the intervention group, the estimate increases by 1.0892; however, this increase is not statistically significant. Unlike in Grade 6, special education status is not a significant variable for Grade 9. The model shows that no variance in scores can be attributed to unexplained school-level differences (ICC = 0). The results were similar when GSVs were used; GSV analyses are presented in Appendix D, Table D4.

Outcomes for Reading Strategy Use

We expected that instruction in a set of cognitive strategies focused on developing a sufficient textbase for text comprehension would improve students' use of reading strategies, though possibly in differential ways depending on grade level.

Equivalence of groups. Independent samples t tests were used to evaluate the null hypothesis that sixth- and ninth-grade intervention students' MARSI pretest scores did not differ significantly from control students MARSI pretest scores. Results showed that sixth graders in the intervention and control conditions were equivalent at the time of the pretest in terms of their reported strategy use for global strategies, $t(159) = -1.599$, $p \leq .11$; support strategies, $t(159) = -.1217$, $p \leq .23$, two-tailed; and the full scale, $t(159) = -0.991$, $p \leq .32$, two-tailed. However, sixth-grade students in the intervention condition reported using significantly fewer problem-solving strategies than their counterparts in the control condition, $t(159) = -2.041$, $p \leq .04$, two-tailed,

at the time of the pretest. Results for ninth grade showed that ninth graders in the intervention and control conditions did not differ significantly at the time of the pretest in terms of their reported strategy use for global strategies, $t(163) = 1.129$, $p \leq .26$, two-tailed; support strategies, $t(163) = 1.463$, $p \leq .15$, two-tailed; problem-solving strategies, $t(163) = 1.548$, $p \leq .12$, two-tailed; and the full scale, $t(163) = 0.165$, $p \leq .87$, two-tailed.

Impacts on sixth grade. Table 6 indicates the impact of the targeted intervention on sixth-grade students' strategy use, specifically students' use of global, support, and problem-solving strategies. The unadjusted means for the spring Global MARSI subscale are 2.90 and 2.77 for treatment and control, respectively. The HLM-adjusted means are 2.94 for treatment and 2.76 for control, with an estimated impact of 0.179. However, this difference between treatment and control groups on global strategy use is not significant ($ES = 0.232$, $p = .102$). For problem-solving strategy use, the unadjusted means for the spring Problem-Solving MARSI subscale are 3.40 and 3.24, respectively. The HLM-adjusted means are 3.45 for treatment and 3.20 for control, with an estimated impact of 0.244. The treatment group reported significantly more use of problem-solving strategies than the control group ($ES = 0.269$, $p = .045$). For support strategy use, the unadjusted means are 2.67 and 2.61 for treatment and control, respectively. The HLM-adjusted means are 2.70 for treatment and 2.59 for control, with an estimated impact of 0.105. However, this difference between treatment and control is not significant ($ES = 0.133$, $p = .357$). Thus, the HLM analysis revealed significant differences between treatment and control groups on one strategy use subscale, Problem-Solving. That is, students who received the LSC intervention were more likely than their control-group peers to report using strategies such as visualizing, rereading, adjusting speed, and guessing the meaning of unknown words when they encountered problems with reading a text. Intervention and control students did not differ significantly in their reported use of global strategies such as thinking about reading purpose, previewing the text, or making decisions about what to read closely or what to ignore. Similarly, intervention students were not more likely than control-group students to use support strategies such as self-questioning, paraphrasing, summarizing, or note-taking.

Appendix E shows a summary of the model results when significant variables were used as covariates. As this appendix illustrates, there are no significant school-level variables for any of the three MARSI subscales. At the student level, the fall score (centered at the school mean) for each subscale is significant.

Appendix E shows the model results for the Global strategy subscale. For students who scored at the school mean in the fall and were in the control group, the estimate is 2.758. The estimate increases by 0.297 for every unit greater than the school average on the fall Global strategy use subscale. The estimate increases by 0.179 if the student was in the intervention group; however, the increase is not statistically significant. This further indicates that the intervention did not appear to have a significant impact on sixth-grade students' reported use of global reading strategies. The model yielded an ICC of .0303 for global strategy use, meaning that there were no unexplained differences among schools.

Table E2 in Appendix E illustrates the model results for sixth-grade problem-solving strategy use. If a student was in the control group and scored at the school average on the fall MARSI Problem-Solving subscale, the estimate of the spring problem-solving strategy use score is 3.2036. The estimate increases by 0.3416 for each unit greater than the school average on the fall Problem-Solving strategy use subscale. If the student was in the intervention group, the estimate increases by 0.2439 for spring problem-solving strategy use, and this variable is statistically significant ($p < .0001$). This further illustrates the impact of the LSC on students' reported use of problem-solving strategies. The model yielded an ICC of .0269 for problem-solving strategy use, indicating no unexplained differences among schools.

Table E3 in Appendix E shows the model results for sixth-grade support strategy use. If a student scored at the school mean on the fall MARSI Support subscale and was in the control group, the estimate of the spring Support strategy use score is 2.5903. The estimate increases by 0.3433 for every unit greater than the school average on the fall Support strategy use subscale. If the student was in the intervention group, the estimate increases by 0.1047 for spring support strategy use. However, this increase is not significant, indicating no impact of the LSC on students' reported use of support reading strategies. The model yielded an ICC of .0119 for support strategy use, which means there were no unexplained differences among schools.

Impacts on ninth grade. Table 6 indicates the impact of the targeted intervention on ninth-grade students' reading strategy use

Table 6
Overall Impact of the Intervention on Strategy Use

	Unadjusted *M*		HLM-adjusted *M*				
Posttest subscales	Control[a]	Treatment[b]	Control[a]	Treatment[b]	Estimated impact	Effect size	*p*
6th grade MARSI							
Global Awareness	2.77	2.90	2.76	2.94	0.179	0.232	.102
Problem Solving	3.24	3.40	3.20	3.45	0.244	0.269	.045
Support	2.61	2.67	2.59	2.70	0.105	0.133	.357
9th grade MARSI							
Global Awareness	2.73	2.74	2.76	2.73	−0.037	0.055	.718
Problem Solving	3.14	3.17	3.23	3.17	−0.065	0.079	.572
Support	2.48	2.47	2.56	2.48	−0.088	0.118	.400

Note. The number of schools for sixth grade is 12. The number of schools for ninth grade is 11. HLM = hierarchical linear model; MARSI = Metacognitive Awareness of Reading Strategies Inventory.
[a] Sixth grade $n = 67$, ninth grade $n = 85$. [b] Sixth grade $n = 94$, ninth grade $n = 80$.

in the three domains: global, problem-solving, and support strategy use. The unadjusted means for the Global MARSI subscale are 2.74 and 2.73 for treatment and control groups, respectively. The HLM-adjusted means for global strategy use are 2.73 for treatment and 2.76 for control, with an estimated impact of −0.037. However, the differences between the two groups are not significant ($ES = -0.055$, $p = .718$). For the Problem-Solving strategy use subscale, the unadjusted means for treatment and control are 3.17 and 3.14, respectively. The HLM-adjusted means for problem-solving strategy use are 3.17 for treatment and 3.23 for control, with an estimated impact of −0.065. The differences between treatment and control groups are not significant ($ES = -0.079$, $p = .572$). For the Support strategy use subscale, the unadjusted means for treatment and control groups are 2.47 and 2.48, respectively. The HLM-adjusted means for support strategy use are 2.48 for treatment and 2.56 for control, with an estimated impact of −0.088. These differences are not significant ($ES = -0.118$, $p = .400$). Thus, the HLM analysis indicates no significant differences between treatment and control groups on any reading strategy use subscale.

Appendix E shows a summary of model results when significant variables were used as covariates. As was the case with the sixth-grade results, there are no significant school-level variables for the strategy-use subscales. For ninth-grade students, the only significant student-level variables are the fall strategy subscale scores, centered at the school mean for each subscale. As shown in this appendix, each model for the MARSI subscales yielded a low ICC, and this reveals evidence of unexplained differences among schools.

Table E4 shows the model results for the Global strategy subscale. If a student was in the control group and had the average fall global score, then the estimate for the spring score is 2.76. The estimate increases 0.4037 for each unit greater than school average fall Global strategy subscale score. If the student was in the treatment group, the estimate decreases by 0.0370; however this decrease is not statistically significant. This further indicates no significant impact of the LSC on ninth-grade students' reported use of global reading strategies.

Table E5 shows model results for the Problem-Solving strategy subscale. The estimate of the spring Problem-Solving strategy use score is 3.2310 if a student scored at the fall school average and was in the control group. The estimate increases by 0.5581 for every unit greater than the school average Problem-Solving subscale score. If a student was in the intervention group, the estimate decreases by 0.0647; however, this decrease is not significant. This lack of significance indicates no impact of the LSC on ninth-grade students' reported use of problem-solving strategies.

Table E6 illustrates that the estimate of the spring Support strategy use score is 2.5636 if a student was in the control group and scored at the school average on this subscale in the fall. For each unit greater than the fall school average Support strategy subscale score, the estimate increases by 0.4618. If the student was in the treatment group, the estimate decreases by 0.0881; however this decrease is not significant. Thus, this illustrates the lack of impact of the LSC on ninth-grade students' reported use of support reading strategies.

Discussion and Conclusions

The overarching purpose of this study was to examine the impact of the LSC on the reading comprehension and strategy use of struggling adolescent readers. Strategies for word identification, vocabulary, visualizing, paraphrasing, self-questioning, and sentence writing were taught to sixth- and ninth-grade students to help them access and understand text. Because it was expected that younger and older adolescent students might respond to strategy instruction differently, this study focused on the comprehension effects for students in sixth and ninth grades. On the basis of the HLM analyses of pre- to posttest gains in reading comprehension and strategy use, the intervention had a positive impact on sixth-grade students' reading comprehension and reported use of problem-solving strategies but had no significant impact on ninth-grade students' reading comprehension or reported strategy use over the course of a school year.

Although sixth-grade students seemed to benefit from the LSC in this study, ninth-grade students in the intervention treatment group did not significantly outperform students in the control group. The dissimilarity in impacts for sixth- and ninth-grade students raises questions about the point at which strategy-based interventions such as the LSC are most beneficial to struggling students and points to a difference in the developmental needs of younger and older adolescents. Because learning to read well is an evolving process that occurs across the lifespan (Alexander, 2005–2006; Jacobs, 2008), it is important to consider the ways in which struggling students in the early stages of adolescence might differ from struggling students in a later period of adolescence in terms of their reading development and the extent to which these differences influence students' responsiveness to interventions.

In construction–integration models for reading processing (Kintsch, 1998; Kintsch & Kintsch, 2005), immature readers use words, sentences, and sequences of ideas to construct a textbase, whereas mature readers use prior knowledge and experience to go beyond the text to make deep-level inferences and elaborations. The students in this study were taught decoding and vocabulary strategies to access the text and comprehension strategies that focused primarily on using the information in the text to construct a textbase. Such instruction made a difference for sixth-grade readers and gave them tools for constructing meaning. However, this instructional approach did not appear to work as well for ninth-grade readers, who likely had already developed base-level comprehension strategies to some extent. In fact, some research has indicated that less knowledgeable readers construct a more effective textbase after strategy instruction, whereas more knowledgeable readers become more adept at inference and elaboration after strategy instruction, especially when that instruction focuses on helping them go beyond the text (McNamara et al., 2006).

It may be that struggling readers in later stages of adolescence need instruction that focuses on constructing a situation model that enables them to effectively integrate their knowledge, experience, and strategies to achieve deep-level comprehension in a variety of contexts for a range of purposes. Indeed, comprehensive strategy programs such as Transactional Strategies Instruction that have yielded success with older adolescents (Anderson, 1992) emphasize higher level comprehension processes such as elaboration. This study suggests that reading comprehension and strategy use might be further enhanced for older adolescents if the instruction

helped students think about and use the strategies in more complex and sophisticated ways that enabled them to go beyond the text.

It is important to note, however, that younger adolescents did benefit from the LSC instruction. Research suggests that early adolescence is the period at which knowledge about text structure and genre become more solidified, and thus readers at this stage of development may experience a shift that enables them to learn and apply basic comprehension processes (Alexander, 2005–2006; Oakhill & Cain, 2007). Because older adolescents already have mastered these basic processes and the complex demands of sophisticated texts require higher level comprehension strategies, they may exhibit less growth when instructed in text-level strategies.

In addition to knowledge of text structures and genres, early adolescents are experiencing shifts in the ways in which they apply reading strategies (Alexander 2005–2006; Jacobs, 2008). With young children, metacognitive awareness and use of strategies improves over time. Students become more aware of and able to use reading strategies by early adolescence (Baker, 1984; Baker & Brown, 1984; Cross & Paris, 1988; Garner, 1987; Myers & Paris, 1978). Studies have indicated that although students may have declarative and procedural knowledge about particular reading strategies just prior to adolescence, they may not develop the conditional knowledge that results in the actual use of the strategies until they get a bit older (Kobasigawa, Ransom, & Holland, 1980). Thus, it is possible that students are ready for strategy instruction in early adolescence that enables them to construct an effective textbase.

The theories that frame this article also acknowledge the significance of context in influencing the reading process (Alexander, 2005–2006; Graesser, 2007; Kintsch, 1998). Factors such as the complexity of the text and the reader's interest can influence a readers' success. One marked difference between sixth- and ninth-grade struggling readers is the length of time they have experienced difficulty with reading and the effect that increasingly complex texts may have on readers' abilities to effectively employ reading strategies. By ninth grade, students have experienced extended failure in reading and are often significantly behind their peers, and the texts they encounter in school are exceedingly complex. Such extended failure with reading comprehension can contribute to disengagement or apathy, which "can stifle progress and halt movement toward increased competence" (Alexander, 2005–2006, p. 427). The current study suggests that is helpful to give adolescents strategy instruction early in their adolescent development. Further, although motivation was not a specified variable, this study alludes to the importance of addressing issues of motivation and engagement when providing reading interventions for older adolescents who are struggling (Kamil et al., 2008). Future investigations of adolescent reading interventions would do well to measure aspects of motivation and engagement.

Like other studies focused on teaching students comprehensive sets of strategies (e.g., Brown et al., 1996; Dole, Brown, & Trathen, 1996; Palinscar & Brown, 1984; Paris et al., 1984; Paris & Jacobs, 1984; Paris & Oka, 1986) and those conducted specifically on the LSC (e.g., Clark et al., 1984; Lenz & Hughes, 1990; Woodruff et al., 2002) these findings suggest that the strategies instruction had an effect on comprehension and use of metacognitive strategies, particularly for sixth graders. However, findings from the present study differ from the aforementioned studies in several important ways. First, like Anderson's (1992) study of transactional strategies instruction and Westra and Moore's (1995) study of reciprocal teaching, the present study yielded significant findings with sixth-grade adolescent struggling readers. Second, this study was conducted with a much larger sample across a much longer period of time than previous studies of strategies instruction, suggesting that sixth-grade struggling readers were beginning to internalize the strategic processing routines that would enable transfer to occur. Finally, findings from this study were examined using a randomized controlled field trial and analyzed using multilevel modeling techniques that heretofore had not been used in studies of the impact of strategies instruction on long-term comprehension and strategy use. In light of Slavin et al.'s (2008) synthesis of research on reading programs in middle and high schools and their plea for more rigorous studies, these findings are particularly critical.

The fact that the LSC had a significant impact on struggling sixth-grade readers' reported problem-solving strategy use suggests that the LSC can help struggling students in early adolescence develop at least an awareness of strategies for overcoming or at least compensating for their reading difficulties. This is particularly important, given research that suggests that problem-solving strategies are most associated with skilled reading (Cantrell & Carter, 2009; Mokhtari & Reichard, 2002). The lack of significant findings related to the reported use of global and support strategies was somewhat expected, given that the intervention instruction focused primarily on the set of single strategies of paraphrasing, self-questioning (support strategies), and vocabulary development (a global strategy) rather than the use of the range of global and support strategies as a whole. The monitoring-based problem-solving strategies were emphasized in conjunction with each of the individual LSC processes, because monitoring is central to the integration of the strategies as a set.

Although it is useful to examine students' perceptions about their strategy use, it is important to note that the MARSI has some inherent limitations. First, the MARSI is a self-report measure and is subject to problems typically associated with self-report measures (Hadwin et al., 2001). In addition, the MARSI results are affected by a number of other methodological limitations such as potential response bias and testing effects. Although the think-alouds that were administered as part of the validation process for this study provide some added confidence in the usefulness of the MARSI data, it is important to note that response rate and sample size for the think-alouds were quite small. Thus, the results of the MARSI analyses should be interpreted with similar cautions that accompany results from standard self-report measures.

The design of this study provides a number of insights regarding the LSC. Whereas previous studies of this intervention program focused on the individual strategy components, this study did not set out to investigate the impact of the individual strategies but instead examined the impact of the LSC as a set of strategies. In addition, previous studies of the LSC focused primarily on adolescents who were receiving special education services. Findings from this study suggest that the LSC has positive benefits, particularly for struggling younger adolescent readers in regular education. Finally, this study provides empirical evidence about the impact of the LSC using a randomized pretest–posttest control group design with larger numbers of students than had been available in previous studies.

It is important to recognize that impact is often a function of implementation fidelity, and implementation fidelity is often at its lowest during the early stages of educational innovation. During this year of study, the intervention teachers were learning how to implement the intervention at the same time that they were expected to implement it. Intervention teachers were not fully implementing the LSC, which is typical for teachers who are just learning to implement strategy instruction (e.g., Almasi, 2003; Anderson, 1992; Brown & Coy-Ogan, 1993; Duffy, 1993a, 1993b; El-Dinary & Schuder, 1993; Pressley, Schuder, SAIL Faculty and Administration, Bergman, & El-Dinary, 1992). Learning to become an effective teacher of strategic processing is a lengthy process that often takes as many as 3 years to learn and feel comfortable implementing (Pressley, Schuder, et al., 1992; Brown & Coy-Ogan, 1993). The results of this study suggest that the LSC may not need to be implemented for a full 50 min each day to yield benefits for sixth-grade students.

The difference in impact between sixth- and ninth-grade students points to the need to further examine for whom strategy-based interventions such as the LSC work best. The intervention was designed to improve the reading proficiency of adolescents with learning disabilities (Deshler & Schumaker, 1988), and the sample in this study did not provide enough statistical power to investigate the intervention's impact on students with learning disabilities as a subgroup. However, a close examination of the HLM results indicates that standardized comprehension scores were negatively affected by school-level socioeconomic characteristics and that intervention students who were not in special education did make more progress than did students who were in special education. These results suggest the need for future research including analyses that will shed light on the specific subgroups for which the LSC is especially beneficial. In addition, this study points to the need for research on how interventions such as the LSC might be adapted and modified to best meet the needs of older adolescents who struggle with reading.

In addition, although this study focuses primarily on the program's impact in terms of outcomes, it is important to understand the processes involved in helping struggling readers acquire and use cognitive reading strategies. In-depth studies of how teachers support the flexible, fluid use of strategies would enhance the research base on adolescent literacy instruction. Further, research on how adolescents learn to employ and effectively orchestrate cognitive strategies to improve their reading comprehension would enhance educators' understandings of how to best teach adolescents who struggle.

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Appendix A

Description of Learning Strategies Curriculum Strategies

The Word Identification Strategy (DISSECT): Acquisition Strand

Purpose. The word identification strategy helps students learn how to decode multisyllabic words.

Rationale. Students need to be able to break apart longer words to aid in their comprehension.

Mnemonic. The mnemonic for the word identification strategy is DISSECT.

D: "Discover the context." Students are asked to decode the word as best as they can and read to the end of the sentence to discern the context.

I: "Isolate the prefix." Students are asked to look at the beginning of the word to see if they know the prefix and can pronounce it.

S: "Separate the suffix." Students are asked to look at the ending of the work to see if they know the suffix and can pronounce it.

S: "Say the stem." Students are asked to pronounce the stem. If they cannot say the stem after isolating the beginning and ending, they move to the next step.

E: "Examine the stem." Students are asked to use the "rule of twos and threes: If a stem begins with a vowel, separate the first two letters to pronounce, or if a stem begins with a consonant, separate the first three letters to pronounce" (Lenz, Schumaker, Deshler, & Beals, 2007, pp. 25–26).

C: "Check with someone." If the students cannot pronounce the word after these steps, they are told to ask someone else for help.

T: "Try the dictionary." If they need additional help, they should find the word in the dictionary.

Note. Summarized from *Learning Strategies Curriculum: The Word Identification Strategy*, B. K. Lenz, J. B. Schumaker, D. D. Deshler, and V. L. Beals.

The Visual Imagery Strategy (SCENE): Acquisition Strand

Purpose. The visual imagery strategy helps students draw mental pictures while reading.

Rationale. Students who do this are actively interacting with the text, paying close attention to the text, tying the text to their past learning, and putting the text in their own words.

Mnemonic. The mnemonic for the Visual Imagery strategy is SCENE.

(*Appendices continue*)

S: "Search for picture words." Students are asked to read several sentences in a text and look for words that elicit a picture in their mind.

C: "Create or Change the scene." Students are asked to use the picture words to imagine a scene.

E: "Enter lots of details." Students are asked to add many details to the scene in their minds from all the sentences using the picture words.

N: "Name the parts." Students are asked to describe the pieces of the scene using words.

E: "Evaluate your picture." Students are asked to make sure they've included everything from the sentences.

Note. Summarized from *Learning Strategies Curriculum: The Visual Imagery Strategy,* J. B. Schumaker, D. D. Deshler, A. Zemitzsch, and M. M. Warner. © 1993 by The University of Kansas.

The Self-Questioning Strategy (ASKIT): Acquisition Strand

Purpose. The self-questioning strategy helps students learn to ask questions about a text and predict answers.

Rationale. Students who do this are actively interacting with the text, paying close attention to the text, questioning their goals for reading the text, and articulating what they read.

Mnemonic. The mnemonic for the self-questioning strategy is ASKIT.

A: "Attend to clues as you read." Students are asked to identify anything they question as they read a text. They are to look for clues to answer their questions as they read.

S: "Say some questions." Students are asked to create questions that haven't been answered yet.

K: "Keep predictions in mind." Students are asked to guess answers to their questions.

I: "Identify the answers." The students are asked to find the answers in the text.

T: "Talk about the answers." The students are asked to discuss how closely their prediction matches the answer.

Note. Summarized from *Learning Strategies Curriculum: The Self-Questioning Strategy*, J. B. Schumaker, D. D. Deshler, S. M. Nolan, and G. R. Alley. © 1994 by The University of Kansas.

The Paraphrasing Strategy (RAP): Acquisition Strand

Purpose. The paraphrasing strategy helps students read a paragraph and identify the main idea and supporting details.

Rationale. Students who do this are actively interacting with the text, paying close attention to the text, and "chunking" the material from the text into smaller parts, which facilitates recall.

Mnemonic. The mnemonic for the paraphrasing strategy is RAP.

R: "Read a paragraph." Students are asked to "read a paragraph silently."

A: "Ask yourself, 'What were the main idea and details in this paragraph?'" The students ask themselves questions to guide them to the main idea and details.

P: "Put the main idea and details into your own words." Students are asked to write the main idea and details in language that makes sense to them.

Note. Summarized from *Learning Strategies Curriculum: The Paraphrasing Strategy*, J. B. Schumaker, P. H. Denton, and D. D. Deshler. © 1984 by The University of Kansas.

The LINCS Vocabulary Strategy: Storage Strand

Purpose. The LINCS vocabulary strategy helps students identify, organize and store information.

Rationale. Students are learning how to identify and define words, which increases their ownership of their learning.

Mnemonic. The mnemonic for the Vocabulary strategy is LINCS.

L: "List the parts." Students are asked to identify the vocabulary word and key information.

I: "Identify a reminding word." Students are asked to come up with a known word that reminds them of the vocabulary word.

N: "Note a LINCing story." Students are asked to come up with a story that bridges the vocabulary word with the known word.

C: "Create a LINCing picture." The students are asked to draw a picture that represents the story.

S: "Self-test." Students are asked to check their learning of the vocabulary word by reciting all the parts of their LINCS.

Note. Summarized from *Learning Strategies Curriculum: The LINCS Vocabulary Strategy,* E. S. Ellis. © 2003 by Edge Enterprises, Inc.

The Sentence Writing Strategy (PENS and MARK): Expression Strand

Purpose. The sentence writing strategy helps students learn to write four types of sentences: simple, compound, complex, and compound–complex.

Rationale. This is the recommended first strategy to teach in the expressions strand because it is the foundation for all the others.

Mnemonic. For the sentence writing strategy, the mnemonic is PENS and MARK.

P: "Pick a formula." Students are to pick one of the formulas to use to create a sentence.

E: "Explore words to fit the formula." Students are asked to think about the words they would use to fit the formula they picked.

N: "Note the words." The students are asked to write down the words.

S: "Search and check." There are several parts to the search and check step; these parts have their own mnemonic, MARK.

M: "Mark out imposters." Students are to cross out the words in the sentence that look like they could be the subject or verb but are not. For example, they would mark out a preposition or an infinitive.

A: "Ask, 'Is there a verb?'" Students are to check their sentence and find the verb.

R: "Root out the subject." The students are asked to check their sentence and find the subject.

K: "Key in on the beginning, ending, and meaning." Students are asked to check for capitalization and punctuation. They are also to check that the sentence is logical when it is read.

Note. Summarized from *Learning Strategies Curriculum: Fundamentals in the Sentence Writing Strategy*, J. B. Schumaker and J. B. Sheldon. © 1998 by The University of Kansas.

Appendix B

Pearson Correlation Matrix of All Variables for Intervention and Control Groups

			MARSI		
Group	NCE	GSV	Global	Support	Problem Solving
6th grade intervention students (n = 94)					
NCE	—	.999**	.162	.065	.244*
GSV		—	.166	.071	.246*
MARSI					
Global			—	.826**	.681**
Support				—	.650**
Problem Solving					—
6th grade control students (n = 67)					
NCE	—	.998**	.159	.019	.099
GSV		—	.148	.011	.084
MARSI					
Global			—	.840**	.702**
Support				—	.711**
Problem Solving					—
9th grade intervention students (n = 80)					
NCE	—	.994**	.111	−.086	.274*
GSV		—	.116	−.067	.289**
MARSI					
Global			—	.792**	.716**
Support				—	.673**
Problem Solving					—
9th grade control students (n = 85)					
NCE	—	.997**	.312**	.235*	.229*
GSV		—	.297**	.216*	.211
MARSI					
Global			—	.748**	.744**
Support				—	.617**
Problem Solving					—

Note. Spring values (posttests).
* Correlation is significant at the .05 level (two-tailed). ** Correlation is significant at the .01 level (two-tailed).

(*Appendices continue*)

Appendix C

MARSI Items Categorized by Subscale

Global Reading Strategies
- I critically analyze and evaluate the information presented in the text.**
- I think about whether the content of the text fits my reading purpose.
- I try to guess what the material is about when I read.
- I check to see if my guess about the text are right or wrong.
- I check my understanding when I come across conflicting information.*
- I think about what I know to help me understand what I read.*
- I have a purpose in mind when I read.**
- I use context clues to help me better understand what I'm reading.
- I use tables, figures and pictures in text to increase my understanding.*
- I skim text first by noting characteristics like length and organization.
- I preview the text to see what it's about before reading it.*
- I use typographical aids like boldface and italics to identify key information.*
- I decide what to read closely and what to ignore.*

Problem-solving Strategies
- I stop from time to time and think about what I'm reading.
- I try to picture or visualize information to help me remember what I read.
- When text becomes difficult, I pay closer attention to what I'm reading.*
- When text becomes difficult, I reread to increase my understanding.
- I try to get back on track when I lose concentration.
- I adjust my reading speed according to what I'm reading.
- I try to guess the meaning of unknown words or phrases.
- I read slowly but carefully to be sure I understand what I'm reading.*

Support Strategies
- I go back and forth in the text to find relationships among ideas in it.**
- I ask myself questions I like to have answered in the text.
- I paraphrase (restate ideas in my own words) to better understand what I read.
- I summarize what I read to reflect on important information in the text.**
- I discuss what I read with others to check my understanding.
- I underline or circle information in the text to help me remember it.
- I take notes while reading to help me understand what I read.
- I use reference materials such as dictionaries to help me understand what I read.**
- When text becomes difficult, I read aloud to help me understand what I read.*

Note. Adapted from "Assessing Students' Metacognitive Awareness of Reading Strategies," K. Mokhtari & C. A. Reichard, 2002, *Journal of Educational Psychology, 94,* Appendix B, p. 258.

* Strategy used by at least one student during the think-aloud. ** Strategy used more than 10 times during the think-aloud and included in the validation analysis.

Appendix D

Summary of Hierarchical Linear Model Results for Sixth and Ninth Grade Student Achievement

Table D1
Sixth Grade Student Achievement, NCE Scores: Summary of Model Results

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Intercept	24.7287	2.8542	10	8.66	<.0001
School: Proportion of free & reduced-price lunch students	−0.3221	0.1501	286	−2.08	0.0385
Fall NCE scores, centered	0.7190	0.07574	286	9.49	<.0001
Intervention	2.7551	1.2898	286	2.14	0.0335
Student: Not in special ed	5.2058	2.7412	286	1.90	0.0586
Student: Reading/writing special ed	2.2202	2.9821	286	0.74	0.4572
Random effects					
Variance components				ICC	
Level 2 random intercept: School	9.05			0.0693	
Level 1 residual: Student	121.55				

Note. Pr = probability; NCE = normal curve equivalent; ICC = intraclass correlation coefficient.

Table D2
Sixth Grade Student Achievement, GSV Scores: Summary of Model Results

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Fixed effects					
Intercept	431.93	4.1472	10	104.15	<0.0001
School: Proportion of free & reduced-price lunch students	−0.4463	0.2172	286	−2.05	0.0408
Fall GSV scores, centered	1.0314	0.1102	286	9.36	<0.0001
Intervention	3.9386	1.8763	286	2.10	0.0367
Student: Not in special ed	7.7763	3.9859	286	1.95	0.0520
Student: Reading/writing special ed	3.6870	4.3362	286	0.85	0.3959
Random effects					
Variance components				ICC	
Level 2 random intercept: School	18.81			0.0682	
Level 1 residual: Student	257.23				

Note. GSV = growth scale value; ICC = intraclass correlation coefficient.

Table D3
Ninth Grade Student Achievement, NCE Scores: Summary of Model Results

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Fixed effects					
Intercept	29.6084	2.2381	9	13.23	<0.0001
School: Proportion of free & reduced-price lunch students	−0.2103	0.08527	338	−2.47	0.0141
Fall NCE scores, centered	0.6897	0.08563	338	8.05	<0.0001
Intervention	1.0892	1.4214	338	0.77	0.4440
Student: Not in special ed	3.3795	2.2672	338	1.49	0.1370
Student: Reading/writing special ed	0.7403	2.6030	338	0.28	0.7763
Random effects					
Variance components				ICC	
Level 2 random intercept: School	0.0			0.0	
Level 1 residual: Student	172.61				

Note. NCE = normal curve equivalent; ICC = intraclass correlation coefficient.

(*Appendices continue*)

Table D4
Ninth Grade Student Achievement, GSV Scores: Summary of Model Results

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Fixed effects					
Intercept	461.42	2.8219	9	163.51	<0.0001
School: Proportion of free & reduced-price lunch students	−0.2449	0.1075	338	−2.28	0.0234
Fall GSV scores, centered	0.8156	0.1080	338	7.55	<0.0001
Intervention	1.7837	1.7921	338	1.00	0.3203
Student: Not in special ed	4.1151	2.8587	338	1.44	0.1509
Student: Reading/writing special ed	0.1297	3.2820	338	0.04	0.9685
Random effects					
Variance components				ICC	
Level 2 random intercept: School	0.0			0.0	
Level 1 residual: Student	274.40				

Note. GSV = growth scale value; ICC = intraclass correlation coefficient.

Appendix E

Summaries of HLM Model Results for Sixth and Ninth Grade Global, Problem Solving, and Support Strategy Use

Table E1
Sixth Grade Strategy Use, Global Awareness: Summary of Model Results, Spring 2007

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Fixed effects					
Intercept	2.758	0.0914	10	30.19	<0.0001
Sixth grade fall Global Awareness, centered at school mean	0.297	0.0780	148	3.81	0.0002
Intervention	0.179	0.1084	148	1.65	0.1015
Random effects					
Variance components				ICC	
Level 2 random intercept: School name	0.013			.0284	
Level 1 residual: Student	0.451				

Note. Pr = probability; ICC = Intraclass correlation coefficient.

Table E2
Sixth Grade Strategy Use, Problem Solving: Summary of Model Results, Spring 2007

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Fixed effects					
Intercept	3.2036	0.1010	10	31.73	<0.0001
6th grade fall Problem Solving, centered at school mean	0.3416	0.0759	148	4.50	<0.0001
Intervention	0.2439	0.1207	148	2.02	0.0451
Random effects					
Variance components				ICC	
Level 2 random intercept: School name	0.015			.0269	
Level 1 residual: Student	0.554				

Note. Pr = probability; ICC = Intraclass correlation coefficient.

Table E3
Sixth Grade Strategy Use, Support Strategies: Summary of Model Results, Spring 2007

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Fixed effects					
Intercept	2.5903	0.0904	10	28.66	<0.0001
6th grade fall Support Strategies, centered at school mean	0.3433	0.0736	148	4.66	<0.0001
Intervention	0.1047	0.1132	148	0.92	0.3567
Random effects					
Variance components				ICC	
Level-2 random intercept: School name	0.006			.0119	
Level-1 residual: Student	0.496				

Note. Pr = probability; ICC = Intraclass correlation coefficient.

Table E4
Ninth Grade Strategy Use, Global Awareness: Summary of Model Results, Spring 2007

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Fixed effects					
Intercept	2.7614	0.0759	10	36.39	<0.0001
9th grade fall Global Awareness, centered at school mean	0.4037	0.0712	152	5.67	<0.0001
Intervention	−0.0370	0.1021	152	−0.36	0.7177
Random effects					
Variance components				ICC	
Level-2 random intercept: School name	0.005			0.0123	
Level-1 residual: Student	0.4252				

Note. Pr = probability; ICC = Intraclass correlation coefficient.

Table E5
Ninth Grade Strategy Use, Problem Solving: Summary of Model Results, Spring 2007

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Fixed effects					
Intercept	3.2310	0.0970	10	33.32	<0.0001
9th grade fall Problem Solving, centered at school mean	0.5581	0.0725	152	7.56	<0.0001
Intervention	−0.0647	0.1143	152	−0.57	0.5722
Random effects					
Variance components				ICC	
Level 2 random intercept: School name	0.026			.0467	
Level 1 residual: Student	0.527				

Note. Pr = probability; ICC = Intraclass correlation coefficient.

(*Appendices continue*)

Table E6
Ninth Grade Strategy Use, Support Strategies: Summary of Model Results, Spring 2007

Effect	Estimate	*SE*	*df*	*t*	Pr > |*t*|
Fixed effects					
Intercept	2.5636	0.0933	10	27.47	<0.0001
9th grade fall Support Strategies, centered at school mean	0.4618	0.0687	152	6.72	<0.0001
Intervention	−0.0881	0.1043	152	−0.84	0.3996
Random effects					
Variance components				ICC	
Level 2 random intercept: School name	0.030			.0631	
Level 1 residual: Student	0.439				

Note. Pr = probability; ICC = Intraclass correlation coefficient.

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