

Increasing Reading Comprehension and Engagement Through Concept-Oriented Reading Instruction

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Based on an engagement perspective of reading development, we investigated the extent to which an instructional framework of combining motivation support and strategy instruction (Concept-Oriented Reading Instruction—CORI) influenced reading outcomes for third-grade children. In CORI, five motivational practices were integrated with six cognitive strategies for reading comprehension. In the first study, we compared this framework to an instructional framework emphasizing Strategy Instruction (SI), but not including motivation support. In the second study, we compared CORI to SI and to a traditional instruction group (TI), and used additional measures of major constructs. In both studies, class-level analyses showed that students in CORI classrooms were higher than SI and/or TI students on measures of reading comprehension, reading motivation, and reading strategies.

A widespread goal of education in the elementary grades is reading comprehension for all students. Reading comprehension becomes especially important in the later elementary grades (Sweet & Snow, 2003) and provides the basis for a substantial amount of learning in secondary school (Kirsch et al., 2002). Without the skills of reading comprehension and the motivation for reading to learn, students' academic progress is limited (Alvermann & Earle, 2003).

In view of the prominence of reading comprehension, a vital issue for educational psychology is investigating the characteristics of effective instruction for reading comprehension (Hiebert & Raphael, 1996). The growing knowledge base about instruction for reading comprehension is rightly directed toward identifying classroom practices with known effects on specific aspects of reading, and a major focus of this research has been on identifying effective reading strategies that increase children's comprehension (Block & Pressley, 2002; Duke & Pearson, 2002; National Reading Panel, 2000). However, the evidence rests primarily on instructional research in which single cognitive strategies, such as questioning, are taught in controlled experiments. Relatively little investigation has been conducted on how multiple strategies can be combined in long-term comprehension instruction within the classroom, and

more studies of this kind are needed (Snow, 2002). Even fewer investigations have addressed issues related to motivation in reading instruction.

Central to the rationale for this investigation is the finding that motivation and engagement contribute to reading comprehension. It is increasingly evident that the acquisition of reading strategies and reading comprehension skills demands a large amount of effort and motivation (Stipek, 2002) and that outstanding teachers invest substantial time and energy in supporting students' motivation and engagement in reading (Dolezal, Welsh, Pressley, & Vincent, 2003). One reason that motivation and engagement may influence the development of reading comprehension is that motivated students usually want to understand text content fully and, therefore, process information deeply. As they read frequently with these cognitive purposes, motivated students gain in reading comprehension proficiency (Guthrie, Wigfield, Metsala, & Cox, 1999). However, motivation and engagement have rarely been incorporated into experimental studies of instruction or interventions for reading comprehension. Consequently, the major purposes of this investigation were to implement reading comprehension instruction that combined support for motivation and cognitive strategies in reading and to compare this instruction with alternative reading comprehension instructional frameworks that do not provide motivation support in terms of their effects on multiple reading outcomes.

The theoretical basis for this investigation of alternative reading comprehension instructional frameworks was our engagement perspective of the development of reading comprehension (Guthrie & Wigfield, 2000). This perspective consists of the following claims: (a) Engagement in reading refers to interaction with text that is simultaneously motivated and strategic, (b) engaged reading correlates with achievement in reading comprehension, (c) engaged reading and its constituents (motivation and cognitive strategies) can be increased by instructional practices directed toward them, and (d) an instructional framework that merges motivational and cognitive strategy support in reading will increase engaged reading and reading comprehension. We elaborate each of these points next.

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This perspective first suggests that engaged reading is based on motivational and cognitive characteristics of the reader. According to our definition, the engaged reader is intrinsically motivated, builds knowledge, uses cognitive strategies, and interacts socially to learn from text. These engagement processes can be observed in students' cognitive effort, perseverance, and self-direction in reading. Various investigators assign a range of meanings to the term *engagement*. One meaning is *time on task*, which has been used to refer to paying attention to text, concentrating on text meaning, and sustaining cognitive effort (Berliner, 1979; Dolezal et al., 2003; Stipek, 2002). A second meaning of engagement emphasizes *affect* surrounding engagement, which is "active, goal-directed, flexible, constructive, persistent, focused interactions with the social and physical environments" (Furrer & Skinner, 2003, p. 149). In contrast, disaffection (the opposite of engagement) refers to individuals who are "alienated, apathetic, rebellious, frightened or burned out, and turn away from opportunities for learning" (Furrer & Skinner, 2003, p. 149). A third meaning of engagement is more *cognitive*, pointing to the depth of processing during learning. Cognitively engaged students think conceptually during learning activities and use strategies such as comprehension monitoring during learning (Meece, Blumenfeld, & Hoyle, 1988). A fourth meaning is more *activity* based, referring to amount and diversity of students' reading activities in and out of school (Guthrie, Schafer, & Huang, 2001; Kirsch et al., 2002).

These definitions of engagement contain two common ingredients. One is that students are relatively energized, active, effortful, and involved in reading. A second ingredient in most of these definitions is that students use their cognitive systems fully, with an emphasis on either cognitive strategies or conceptual knowledge. Engaged reading refers not to any form of effort (such as completing a routine task quickly), but to effort derived from using complex strategies or deep knowledge for learning from text. We, therefore, believe the definitions of engagement focused primarily on behavior are necessary, but not sufficient, conditions for engagement. The strategic and motivational aspects of engagement also are needed. However, we expect that there is a correlation among these meanings, and that students who are engaged readers, by our definition, are also likely to be engaged readers according to the other four definitions. In this investigation, we emphasized three characteristics of engaged reading; cognitive strategy use, reading motivation, and reading comprehension. We did not specifically study the social interaction aspect of engaged reading within our definition because of resource limitations, but, as will be seen, we did incorporate it into one of our instructional models.

Our engagement perspective on reading development suggests that students' amount of engaged reading correlates with achievement in reading comprehension, and there is evidence to support this view stemming from each definition of engagement presented previously. Time on task was shown quantitatively to predict reading achievement in classroom observations (Berliner, 1979) and is claimed to be associated with reading achievement in Grades 3–5 in qualitative studies (Dolezal et al., 2003). Positive affect as an engagement variable is associated with academic achievement in reading and math (Skinner & Belmont, 1993; Skinner, Wellborn, & Connell, 1990). Learning science with cognitive engagement is associated with relatively high achievement in those topics (Blumenfeld & Meece, 1988; Meece et al., 1988). As for the activity definition of engagement, studies show that reading frequently in a broad range of text types (fiction and

nonfiction books) is associated with reading achievement among elementary students in national samples (Guthrie et al., 2001) and middle school students in international samples that include the USA (Kirsch et al., 2002), with multiple controls for socioeconomic status and previous achievement.

Our engagement perspective on reading comprehension suggests further that engaged reading and its constituents (motivation and cognitive strategies) can be increased by instructional practices directed toward them. In keeping with our suggestion that intrinsic motivation and cognitive strategies are central to engaged reading, we next review evidence that instructional practices may increase the motivational aspect.

Researchers have identified a variety of instructional practices that foster children's self-efficacy and intrinsic motivation for learning (see Ames, 1992; Ryan & Deci, 2000; Schunk & Pajares, 2002; Stipek, 1996, 2002, for reviews). Students' self-efficacy for reading is enhanced when they learn reading strategies and have opportunities for success in reading (Schunk & Pajares, 2002). Guthrie and Humenick (in press) performed a meta-analysis of studies that manipulated several aspects of intrinsic motivation support for reading. From 22 such studies, they computed 131 effect sizes between experimental and control conditions. The four instructional practices included in this experimental work were (a) content goals for instruction, (b) choice and autonomy support, (c) interesting texts, and (d) collaboration for learning.

When content goals were prominent in reading in these studies, students focused on gaining meaning, building knowledge, and understanding deeply, rather than on skills or rewards. For example, when fifth-grade students were given content learning goals for reading, they gained more conceptual knowledge than when they were given performance goals of scoring well on tests (Grolnick & Ryan, 1987). In the meta-analysis, the mean effect size for the contributions of content goals to motivation was 0.72, and the mean effect size for the benefits of content goals to reading achievement was 0.87. These findings suggest that meaningful conceptual content in reading instruction increases motivation for reading and text comprehension.

Affording students choices of texts, responses, or partners during instruction was the second motivation-supporting practice. For example, students provided choice of texts performed higher on several reading tasks than students with no choice (Reynolds & Symons, 2001). The mean effect size of choice on motivation was 0.95, and the effect size of choice on text comprehension was 1.2. The third practice was using interesting texts, which refers to topic interest, format appeal, and relevance of textual materials. The mean effect size of interesting texts was 1.15 on motivation and 1.64 on text comprehension. Social collaboration during reading, which includes social goals and collaborative activities, was the fourth motivation-supporting practice. Mean effect sizes for collaboration were 0.52 for motivation, and 0.48 for text comprehension. Motivation-supporting practices appear to increase motivation and text comprehension in controlled laboratory-based studies.

Although the effects of some motivational practices for reading comprehension have been verified in controlled studies, these practices have rarely been examined in classroom contexts. Exceptions include Stipek (2002), who found that reading engagement of third-grade students (attentiveness, involvement, enthusiasm for reading tasks in the classroom) was significantly correlated with the teacher posing conceptual problems, use of

meaningful texts for instruction, and active collaboration about text meaning. Similarly, Taylor, Pearson, Clark, and Walpole (2000) observed that students' time spent engaged in reading tasks in the classroom was correlated with ratings of the extent to which the teacher provided small-group instruction and effective scaffolding for difficult cognitive reading strategies. Among first-grade teachers nominated to be effective, the amount of student engagement in literacy activities was observed to vary substantially with practices such as content goals, choices, collaborations, effective scaffolding, and others (Bogner, Raphael, & Pressley, 2002), which confirmed findings with fifth-grade teachers (Pressley, Wharton-McDonald, Mistretta-Hampston, & Echevarria, 1998). Consistent with these recommendations, at least one quasi experiment has shown that when the motivational practices of using content goals, student autonomy support, hands-on activities, interesting texts, and collaboration were combined in long-term classroom instruction, motivation increased in comparison to traditional instruction (TI; Guthrie, Wigfield, & VonSecker, 2000). Additional classroom-based studies are needed to assess the effects of building motivation support into reading comprehension instruction programs.

A second major component of our engagement perspective is cognitive strategy use during reading. A substantial body of research suggests that reading comprehension instruction should include explicit cognitive strategy instruction (SI). For students in the later elementary grades (3–5), reading comprehension is correlated with a range of cognitive and metacognitive strategies. These include (a) activating background knowledge for the purpose of understanding text that contains similar information (Dole, Valencia, Greer, & Wardrop, 1991), (b) generating questions related to the topic of the text being read (Rosenshine, Meister, & Chapman, 1996), (c) summarizing text (Armbruster, Anderson, & Ostertag, 1987), (d) searching for information in texts and documents (Dreher & Brown, 1993), (e) organizing information graphically for the purpose of improved comprehension (Armbruster, Anderson, & Meyer, 1991), (f) learning the structures of stories (Fitzgerald & Spiegel, 1983) and the themes of narratives (Williams et al., 2002), and (g) monitoring comprehension during reading (Baker & Zimlin, 1989).

Complementing the findings that these cognitive and metacognitive strategies correlate with comprehension, instructional research shows that *strategy training* can increase students' competence in using the strategy, awareness of the strategy, and comprehension of text for which the strategy was intended (National Reading Panel, 2000). Furthermore, controlled studies of single strategies have shown that SI is effective for students with learning disabilities, as well as for regularly developing students, in the elementary grades. Reviewing 16 studies of teaching strategies for expository text to learning disabled students, Gersten, Fuchs, Williams, and Baker (2001) observed moderate positive effects on reading comprehension for teacher modeling and monitoring of strategy use.

Although these cognitive and metacognitive strategies have been most frequently examined in isolation, some investigations have examined combinations of strategies. For example, reciprocal teaching (Palincsar & Brown, 1984) integrates the four strategies of predicting, clarifying, questioning, and summarizing. A combination of multiple strategies was included in the framework known as transactional strategies instruction and found to be effective for early elementary school students (Brown, Pressley, Van Meter, &

Schuder, 1996). Klingner, Vaughn, and Schumm (1998) taught the strategies of previewing, monitoring, summarizing, and questioning concurrently, with significant benefits on a standardized reading test. With respect to motivation, strategy training may affect students' self-efficacy because providing students with cognitive tools that help them perform better has been shown to increase students' self-efficacy in reading and other achievement areas (see Bandura, 1997; Schunk & Zimmerman, 1997). However, relatively little research has been conducted in which these cognitive and metacognitive strategies have been combined with motivational practices into frameworks that are sustainable in long-term classroom practice.

Our theoretical perspective on engagement suggests finally that merging motivational and cognitive strategy support in reading comprehension instruction will increase engaged reading and reading comprehension. In this investigation, we compared instruction that explicitly integrates motivation and cognitive support for reading comprehension with instruction that provides explicit cognitive support but not motivation support. If integration of motivation and cognitive support increased reading comprehension more than cognitive support only, we would infer that the motivational practices are beneficial. It is noteworthy that the motivational practices may have multiple effects on the learner, including cognitive and conceptual consequences as well as motivational influences. For example, a teacher who provides a choice of which book to read in a classroom is providing autonomy support, which is known to be motivating. Having selected a book, the student may be expected to read more deeply than a student who was assigned a book, and the student may use cognitive strategies more fruitfully to gain meaning from the text. Consequently, the motivational practice of affording choice may have benefits for students' knowledge acquisition and cognitive strategy improvement as well as their motivational development. Therefore, we were not attempting to identify all of the aspects of students' learning that are responsible for the possible improvement in reading comprehension in our intervention. Our purpose was to attempt to determine whether instructional practices that combine motivation and cognitive support would increase reading comprehension as well as motivational and cognitive aspects of reading engagement.

Utilizing previous research on motivation-supporting practices and cognitive SI, we designed an instructional framework to integrate them explicitly. We constructed Concept-Oriented Reading Instruction (CORI) to provide a classroom context where the multiple strategies of activating background knowledge, questioning, searching for information, summarizing, organizing graphically, and structuring stories would be taught. We intentionally merged these strategies with the multiple motivational practices of (a) using content goals in reading instruction, (b) providing hands-on activities, (c) affording students choice, (d) using interesting texts, and (e) promoting collaboration in reading instruction (a more detailed description of CORI is provided later). Although previous studies showed that CORI surpassed TI in reading comprehension, strategy learning (Guthrie et al., 1998, 1999), and reading motivation (Guthrie et al., 2000), the relative benefit of the motivational practices and cognitive SI has not been examined. In the two studies reported here, we attempted to investigate whether the integration of cognitive and motivational support benefited students more than multiple cognitive SI without explicit motivational support.

In the first study, we examined the extent to which a combination of motivation-supporting practices and cognitive SI influenced students' reading comprehension, strategy use, and motivation compared with a condition of cognitive SI only. A second study was conducted for purposes of confirmation and generalization. The major purposes were the same as in Study 1, but in the design of Study 2, a second comparison group, TI, was included. This group had relatively little explicit SI in reading. Outcome measures included reading comprehension, cognitive reading strategies, and reading motivation. Both the Gates-MacGinitie Reading Comprehension Test (MacGinitie, MacGinitie, Maria, & Dreyer, 2000) and a new measure of motivation based on teachers' ratings of student motivation were added. These new measures of reading comprehension and reading motivation were intended to examine whether the findings of Study 1 were generalizable to new indicators of the same variables. At the same time, measures of passage comprehension and reading strategies from Study 1 were used to link Studies 1 and 2.

The questions guiding this investigation were as follows:

1. To what extent does CORI differ from SI and TI in influencing reading comprehension of Grade 3 students?
2. To what extent does CORI differ from SI in influencing reading motivation of Grade 3 students?
3. To what extent does CORI differ from SI in influencing comprehension strategies of Grade 3 students?

Study 1

Method

Participants

Third-grade students from four schools in a small city located in a mid-Atlantic state participated with permission from their parents. The demographic characteristics of the participants are presented in Table 1. According to chi-square tests, the schools did not differ significantly from each other, nor were they significantly different from the district in the student demographic variables in the table. There were 8 CORI classrooms and 11 SI classrooms.

Teachers in the study had the following characteristics. Age ranges were 8 teachers in the 22–30-year-old range, 10 teachers in the 31–45-year-old

range, and 1 teacher in the 46–60-year-old range. Years teaching consisted of 5 teachers with 0–3 years of experience, 5 teachers with 4–10 years, and 9 teachers with 11 or more years. Eighteen teachers held bachelor's degrees, and 1 teacher had a master's degree. Seventeen teachers were female, and 2 were male. Eighteen teachers were Caucasian, and 1 was an ethnic minority.

Design and Procedure

We used an equivalent groups pretest–posttest design (Pedhazur & Schmelkin, 1991). District administrators selected four schools judged to be comparable in demographic characteristics and past reading achievement. We assigned them randomly to either CORI or SI and asked each principal and Grade 3 teacher team if they wished to participate in the defined condition and the professional development for it. Within schools, a few teachers did not participate. In one SI and one CORI school, one teacher declined. Additionally, in one CORI school, one teacher was hired 2 days before the start of school and received no CORI training. In one SI school and one CORI school, the principal was replaced during the study, which reduced the school effects in this investigation. With these constraints, it is reasonable to state that classrooms were the units in which the instruction occurred as well as the units in which the measures were administered.

CORI was implemented in two schools to all third-grade students in eight classrooms. The program was administered for 12 weeks, from the second week in September to the second week in December. Class size in one school averaged 21 students, and the other school averaged 28 students. The model was taught for 90 min daily, in the morning in one school and in the afternoon in the second school. SI was implemented for all third graders in 11 classrooms in two different schools from the second week in September to the third week in December. The model was implemented 90 min each morning in both schools. For CORI and SI models, students who were reading at the end of first-grade level or below in September of Grade 3 were pulled from classrooms and taught by special education teachers for 30 min, approximately three times per week. Struggling readers, who were not eligible for special education or were not more than 2 years below in reading, were taught within CORI and SI classrooms.

Instructional Frameworks

The first instructional approach under investigation was CORI (see Guthrie, Wigfield, & Perencevich, 2004, for a detailed description of CORI). Based on the engagement model of reading development, the CORI approach suggests that reading comprehension is facilitated by reading engagement, which in this study consisted of the joint functioning of cognitive comprehension strategies and motivational processes. Consistent with these relationships, the model suggests that effective instruction for comprehension includes support for motivational, cognitive, conceptual, and social processes within the classroom. Within CORI, students' motivation and engagement were explicitly supported through five practices: (a) using content goals for reading instruction, (b) affording choices and control to students, (c) providing hands-on activities, (d) using interesting texts for instruction, and (e) organizing collaboration for learning from text. SI was intended to support students' development of self-efficacy for reading comprehension.

To implement the practice of using content goals in reading instruction, students were taught reading comprehension in the conceptual theme of ecology in life science, following general science goals prescribed by the county (details about the science activities are presented below). Using content goals in a conceptual theme consists of reading instruction with a complex knowledge domain (ecology, solar system, colonial America, westward expansion) sustained for at least several weeks (Many, Fyfe, Lewis, & Mitchell, 1996). Knowledge content goals provide motivation for students because they provide a purpose for using strategies, such as questioning. In CORI, students perform such strategies as questioning

Table 1
Demographic Characteristics of Students in Study 1

Characteristic	CORI		SI		District %
	<i>n</i>	%	<i>n</i>	%	
Gender					
Male	71	48	102	48	50
Female	77	52	111	52	50
Total	148		213		
Ethnicity					
African American	33	22	47	22	8
Asian	3	2	11	5	2
Caucasian	112	76	155	73	87
Hispanic					2
Other					
Total	148		213		
Free and reduced meals	27	18	47	22	13

Note. CORI = Concept-Oriented Reading Instruction; SI = strategy instruction.

within a meaningful context, which enables students to learn and use the strategies with greater effort, attention, and interest than a context devoid of deep, conceptual themes.

A second CORI motivational practice consists of optimizing student choice during reading comprehension instruction in the classroom. The optimization process enables students to make decisions and choices about tasks and texts in the classroom that are cognitively appropriate and developmentally productive. Choices must be tailored to students' needs and capabilities. For example, students were given individual choices about which birds or animals to study in depth and which information books to read on the topic. Teachers guided students to match texts to their information needs and reading levels. Team sets at team tables were often used for these choices. Such support for autonomy provides intrinsic motivation, which increases effort and persistence in the challenge of learning and gaining command of reading comprehension strategies (Deci & Ryan, 1985; Skinner et al., 1990).

A third practice refers to hands-on experiences related to texts and reading activities. CORI is based on a framework of science inquiry in which students explore ecological issues, such as the survival of birds or aquatic life. Observational activities, systematic investigations, and true experiments provide students with a form of interaction with a topic, such as ecology, that markedly facilitates reading. For example, when students dissect an owl pellet, subsequent reading about owls and the food web in which they exist is energized, long lived, and cognitively sophisticated, compared with a similar reading without the hands-on experience.

The fourth practice of motivational support in CORI is using an abundance of interesting texts for comprehension instruction. We refer to interesting texts as trade books composed by an author and possessing the features of information books, including table of contents, index, illustrations, bold headings, and a coherent array of subsections. Not only are these texts attractive, which compel students' attention and effort, they also afford an opportunity for extended pursuit of knowledge, defined by students' goals and questions. In a classroom, interesting texts serve a crucial role for facilitating strategy development by enabling students to pursue knowledge goals, exercise choices of subtopics for learning, and satisfy curiosities developed from hands-on experiences.

The fifth practice consists of support for student collaboration with a diversity of reading activities. Students' motivation for using complex comprehension strategies is increased when students are afforded opportunities to share their questions, interesting texts, and information being gained. Collaborative activity enables students to clarify their understanding of core concepts of survival, such as defense, predation, or reproduction. Thus, the five practices of motivational support were combined with systematic, explicit instruction in reading comprehension strategies to compose the CORI context for reading development.

In CORI, explicit SI was provided for the following reading comprehension strategies: (a) activating background knowledge, (b) questioning, (c) searching for information, (d) summarizing, (e) organizing graphically, and (f) identifying story structure. Each strategy was taught for one week in the order presented previously (6 weeks), and in the next 6 weeks, strategies were systematically integrated with each other. This sequence enabled students to gain command of the individual strategies, as well as to fuse them in complex comprehension activities in the classroom. Throughout, the strategies were modeled by the teacher and scaffolded according to students' needs, with guided practice provided. This frame is similar to the recommendations and practices for multiple SI, as described in the National Reading Panel (2000) report. Several investigators have detailed reading strategies including explicit teaching for background knowledge, questioning, summarizing, searching for information, organizing graphically, and learning story grammar from literary materials (Trabasso & Bouchard, 2002). SI emphasized the attributes of competence in doing the strategy, awareness of when and how to use each strategy, and self-initiation of the strategy to assure sustained self-regulation of effective reading.

The second instructional framework used as a treatment condition in this study was SI. The implementation was designed to be as similar as possible to existing practices of multiple SI that are consistent with research-based recommendations (National Reading Panel, 2000; Trabasso & Bouchard, 2002) and to the SI in CORI described previously. The SI teachers taught the same county-based life science objectives (with heavy emphasis on ecology) and included the same science observations and activities (e.g., aquariums) as the CORI teachers. SI teachers used information texts for science and social studies as approximately 30% of their reading materials. There was no explicit support for student motivation stipulated in the SI program, although teachers used a variety of practices to motivate their students to read. In particular, SI teachers usually provided support for students' self-efficacy by enabling them to become confident in using strategies as tools to read better, which can facilitate reading self-efficacy (Bandura, 1997). The sequence of strategies was the same in SI and CORI.

Books for Instruction

The CORI classes were provided trade books for two 6-week instructional phases (the phases are described later). In each phase, four class sets (one book for each student) were used. Class sets consisted of two information books, one literary chapter book, and one expressive reading book. In addition, six team sets (one book for each team of four students) were used by heterogeneous reading level teams. Team sets included three information books, two literary stories/chapter books, and one expressive reading book. Project staff assembled a menu of books that had interesting content, a diverse range of difficulty to accommodate heterogeneous reading levels, and text features helpful for SI (see Davis & Tonks, 2004). Teachers selected team sets from this menu of books. At least 25 individual copies of books on the conceptual theme were provided to enable students to complete their projects. Supplementing this minimum, teachers obtained library books and school resources. Students were expected to read a total of at least 16 books in the 12-week unit (see Appendix A). For SI, teachers used the materials in their schools consisting of basal readers, trade books, magazines, and multimedia. They spent substantial time locating books suitable for teaching each of the six strategies in the SI program (Davis & Tonks, 2004).

Science

In CORI, science inquiry was integrated with reading, which has been shown to increase both reading and science comprehension (Romance & Vitale, 1992). The program theme of "Survival of Life on Land and Water" met the district science requirements, as well as the reading and writing requirements. In CORI, this theme was taught in two related 6-week units. Within each 6-week unit, students were taught the theme's nine science core concepts: (a) competition, (b) locomotion, (c) feeding, (d) reproduction, (e) respiration, (f) predation, (g) defense, (h) communication, and (i) adaptation to habitat. In the 6-week terrestrial unit "Birds Around the World," students participated in a habitat walk, specimen collection, feeder observations, feather experiments, and owl-pellet dissection. In the second 6-week unit, students studied life in aquatic environments with a pond observation and an experiment with aquatic insects. Activities such as comparing and contrasting the students' habitat walk in the schoolyard to the child's walk with her grandfather in *Owl Moon* (Yolen, 1987) integrated science with reading. Science processes included using existing knowledge, predicting, collecting data, recording, drawing conclusions, and communicating findings. Science activities in each unit included a spectrum of observational and experimental aspects of the scientific method and were guided by Pedro Barbosa (Barbosa & Alexander, 2004), a biologist on the investigating team; American Association for the Advancement of Science (AAAS) benchmarks; and the school district's goals for third-grade science outcomes.

Professional Development

Summer workshops provided professional development for the two instructional models. CORI teachers participated in a 10-day workshop that included viewing examples of instruction, performing the reading strategies, discussing motivational practices, constructing reading–science integrations, identifying books appropriate for this instruction, and planning for the 12-week theme using a teacher’s guide supplied by the project. SI teachers participated in a 5-day workshop that included viewing examples of instruction, performing the reading strategies, discussing motivational practices, identifying books appropriate for this instruction, and planning 12 weeks of instruction using a teacher’s guide supplied by the project. During the SI workshop, teachers identified books and materials for SI. We provided guidance in how to align texts with specific strategies and how to use available narrative and information texts for instruction in each strategy.

For SI teachers, we discussed the motivational practice of supporting student self-efficacy in reading by enabling students to perceive their improvement in strategies and to set realistic goals for their strategy development. The SI workshop was shorter because teachers did not develop the science activities, other motivational practices, or science–reading integrations. The activities and time devoted to SI training were quite similar across the two workshops, as were the amounts of time teachers had to plan their lessons. An extended description of these workshops and classroom implementation can be found in Guthrie (in press).

Measures

Assessments of reading comprehension, strategy use, and reading motivation were conducted in a pretest in the first week of September 2001 and in a posttest in the third week of December 2001, administered by teachers in their classrooms. In September, all classrooms (8 CORI and 11 SI) were given the full assessments, which required four 60-min periods. School and district administrators considered this testing time excessive. Because the administrators’ continued cooperation was imperative, changes were made to the posttesting in December. The investigators selected approximately half of the classrooms that were representative of the total group (4 CORI and 6 SI); the mean of the selected group on the comprehension pretest was highly similar to the mean of the nonselected group. The selected group was given the full assessment to reduce the testing burden on the students and schools. These classes were used for the data analyses of both pretest and posttest scores.

Overview of the assessment. The assessment consisted of the following: (a) elicitation of background knowledge, (b) student questioning, (c) searching for information, (d) multiple text reading comprehension (writing knowledge gained from text; there were three alternative forms of these tasks to allow counterbalancing across pretest, posttest, and a possible follow-up), (e) Motivation for Reading Questionnaire (MRQ; Wigfield & Guthrie, 1997), and (f) passage comprehension (three parallel forms). The passage comprehension measure required students to read a randomly assigned passage in three alternative forms (bat, bear, shark), followed by a knowledge structure assessment that students completed on the computer.

For the multiple text comprehension, the alternative forms consisted of three reading packets representing multiple trade books developed by the research team. The topics of the three packets were (a) ponds and deserts, (b) rivers and grasslands, and (c) oceans and forests. Each packet contained 75 pages in 22 sections, with 16 sections relevant to the topic and 6 distractors. Packets contained an equal number of easy (Grade 2) and difficult (Grades 4–6) texts, representing the nine ecological concepts and defining information on the biomes. Students were administered the assessments by their classroom teachers. Classrooms were randomly assigned packets so that an equal number of students received each packet. Forms were counterbalanced at pretest and posttest. The packets provided the text base for the assessments of students’ reading strategy use and

comprehension. Next, we describe each specific measure of reading strategy use, comprehension, and motivation included in the assessments.

Background knowledge. After the 5-min warm-up activity of looking at a picture with a partner, students wrote what they knew about living in their assigned biomes (e.g., ponds and deserts, rivers and grasslands, or oceans and forests). They were given 15 min in an open-ended writing activity. Responses were coded to a six-level rubric (see Guthrie & Scaffidi, 2004, for detailed discussion). This task measured prior knowledge about the topic before reading about it in the assessment (see Appendix B). Interrater agreement for 15 responses (approximately 8% of the total) was 100% adjacent and 86% exact. Parallel form, across-time correlation (September to December) was $r(118) = .42, p < .002$, indicating adequate reliability. Predictive validity was indicated by correlations of $r(125) = .41, p < .003$, for background knowledge and reading comprehension in September, and $r(115) = .45, p < .03$, in December. These moderate correlations are comparable to those found by Gottfried (1985, 1990) in parallel form, across time correlations of reading-related measures for children in Grades 3–4. In the pretest, the entering background knowledge of CORI and SI students was not significantly different, showing that they began the intervention similarly knowledgeable about the content of survival in biomes. This similarity facilitated the comparison of the groups in reading comprehension at the time of the posttest.

Questioning. After briefly reviewing the reading packet, students were instructed to write their questions on the topic. During this 15-min period, students were encouraged to write as many good questions as possible about what the biomes were like and how animals survived in them. Questions were coded to a four-level rubric (see Appendix C; Taboada & Guthrie, 2004, discussed this rubric in detail). Interrater agreement on 103 questions for 25 students was 96% for adjacent and 92% for exact coding. Students wrote 0–10 questions and were given a rubric score of 1–4 for each question and a score of zero if they wrote no question. On the basis of 10 possible questions, a student’s score could range from 0–40. Using these scores, Cronbach’s alpha for questioning was .80. Concurrent validity for questioning was estimated by the correlation of $r(119) = .27, p < .05$, between this task and a different, text-based, student-questioning task. In the latter task, students were given a 750-word passage on an animal (e.g., wolf), permitted to browse it for 1 min, and given 10 min to write questions they would like to answer in reading the passage (Taboada & Guthrie, 2004).

Searching for information. Students searched the packets and took notes on what they learned in one 10-min activity and in a subsequent 40-min activity the following day. Students were given general goals for searching, consisting of the following questions: How are the two biomes (e.g., rivers and grasslands) different? What lives in a river? What lives in a grassland? How do they live there? How do they help each other live? Students then selected specific topics for further reading. Parallel form, across-time correlation was $r(116) = .25, p < .001$, indicating moderate–low reliability. Discriminant validity was indicated by the dual conditions of (a) a positive correlation of $r(123) = .23, p < .01$, between number of packet sections that were selected by the students that were relevant to the topic of the search as defined by the guiding questions and multiple text comprehension and (b) a negative correlation $r(123) = -.19, p < .05$, for number of irrelevant sections that were selected with multiple text comprehension.

Multiple text comprehension. In an open-ended, constructed response task, students wrote what they knew after reading. They were given 30 min to express their knowledge, with two statements of encouragement after 7 and 13 min. Written responses were coded to a six-level rubric (see Appendix B). Interrater agreement for 16 responses (8% of the total) was 100% for adjacent and 81% for exact coding. Concurrent validity of this measure was estimated by a correlation of $r(110) = .58, p < .01$, with the computer-based passage comprehension task (described below). Parallel form, across-time correlation was $r(108) = .63, p < .001$, indicating adequate reliability. Concurrent validity of a highly similar measure used in previous research was indicated by its correlation with standardized

reading tests (Guthrie et al., 1998) and with reading grades (Sweet, Guthrie, & Ng, 1998).

Reading motivation. To measure reading motivation, students responded at pretest and posttest to an abbreviated version of the MRQ (Wigfield & Guthrie, 1997), which assesses a variety of students' reading motivations. In this study, we assessed self-efficacy for reading and the intrinsic motivation dimensions consisting of preference for challenge, involvement, and curiosity, using 18 items from the longer MRQ. Examples of the items for self-efficacy: "I am a good reader"; for preference for challenge: "I like hard, challenging books"; for involvement: "I enjoy a long involved story or book"; and for curiosity: "I have favorite subjects I like to read about." The abbreviated version was used for theoretical and practical reasons. Theoretically, our focus in this study was on self-efficacy and intrinsic motivation, and so we included items assessing these constructs. Practically, the abbreviated version reduced the testing time for students, which was a concern in this study.

All items were scored on a Likert-type scale from 1 (*very different from me*) to 4 (*a lot like me*). We conducted a factor analysis on the 18 items. Three factors emerged with eigenvalues larger than 1, accounting for 59% of the variance. For the analyses in this study, we used the factor that best represented the constructs of intrinsic motivation and self-efficacy. Items loading on this factor assessed preference for challenge, involvement in reading, curiosity, and reading self-efficacy, which were verified as scales in previous research (Wigfield & Guthrie, 1997). This factor correlated with reading achievement at the individual level. Cronbach's alpha was .75, and its correlation across time was $r(105) = .41, p < .01$, indicating adequate reliability. At the class level of aggregation, it correlated with multiple text comprehension at $r(9) = .76, p < .05$, and with passage comprehension at $r(9) = .82, p < .05$. The first and third factors were not used because the first factor did not correlate with achievement at the individual level of analysis and the third factor contained only two items that were not double loaded.

Passage comprehension. Students were given one of three parallel forms of this assessment, which consisted of a passage on an animal (sharks, polar bears, or bats). The four-page text was 500 words with illustrations. Sentence length was 7–24 words, and word difficulty was Grade 3, according to teacher ratings. Alternative forms were randomly assigned to classes. We adapted the Pathfinder algorithm, a procedure used with adults, to measure the structure of knowledge gained from text (Johnson, Goldsmith, & Teague, 1994). Students read a paper-based passage for 7 min. Then, students performed a 20-min task on the computer in which they rated the relatedness of word pairs drawn from the paper-based passages on animals. The texts were similar to many texts on animals in Grade 3 classrooms. The vocabulary was neither unfamiliar nor technical. Children perceived the passages as interesting stories about animals rather than hard science reading with difficult words. For the rating task, investigators identified nine key words, and students rated 36 word pairs on the computer. The format was highly related (9), moderately related (5), and not related (1), consistent with previous research (Johnson et al., 1994). The words selected for each animal were as follows: polar bear: *survival, move, protect, steer, webbed, swim, fur, fat, den*; for bat: *survival, eat, protect, blood, insect, lick, hide, escape, shelter*; and for shark: *survival, hunt, birth, smell, stuns, teeth, purse, cord, hatched*. For example, for the polar bear task, students rated pairs such as *steer–move* and *webbed–den*.

Pathfinder, the computer program utilized to analyze these data, computes a correlation (Pearson product–moment correlation) between a student's ratings and an expert's ratings of all pairs (Johnson et al., 1994). These correlation coefficients range from -1 to 1 , and represent a measure of the extent to which the student's knowledge structure approximates that of an expert (Davis, Guthrie, & Scaffidi, 2003; Johnson et al., 1994). Pathfinder also generates graphic network representations for quantitative or qualitative analysis. Cronbach's alpha coefficients were polar bear: .88, shark: .87, and bat: .85. Reliability was further indicated by parallel form, across-time correlation of $r(91) = .60, p < .001$, for this measure. Concurrent validity was shown at the classroom level by correlations of

passage comprehension and multiple text comprehension of $r(9) = .68, p < .05$, in September and $r(9) = .82, p < .01$, in December.

Although Pathfinder is based on word-pair proximity ratings, we used it as a measure of reading comprehension in this study because the scores are sensitive to students' knowledge structure, not merely to vocabulary. Evidence for Pathfinder sensitivity to structural knowledge has been shown by studies indicating that Pathfinder scores were higher for students who read a well-organized version of a text than for students who read a poorly organized version of the same text (Britton & Gulgoz, 1991). In addition, students who were given an elaborative interrogation treatment with a text (why questions) scored higher on Pathfinder than students who read the text twice with no elaborative interrogation treatment (Ozgunor & Guthrie, 2004). In brief, Pathfinder records levels and changes in the structure and precision of students' text-based knowledge, in addition to vocabulary and other comprehension processes.

Organizing information. We formed a measure of students' abilities to organize knowledge learned from text based on the proximity ratings of key words in passages that were used for passage comprehension. The Pathfinder program computes a measure of the coherence of knowledge as well as passage comprehension. Computed by the Pathfinder algorithm, coherence is a measure of the internal consistency of information in the Pathfinder network formed by the reader (Davis et al., 2003; Johnson et al., 1994). High coherence indicates a well-organized knowledge structure, irrespective of its accuracy in comparison to an expert model. The validity of the coherence indicator is verified by its demonstrated sensitivity to students' degree of hierarchical structuring of knowledge and the improvements in their structured knowledge (Ozgunor & Guthrie, 2004). The reliability is shown in a correlation of $r(9) = .70, p < .05$, between parallel forms given in September and December to the classrooms.

Composite of strategies. To examine strategies as a group, we formed a composite consisting of activating background knowledge, searching, and organizing. Questioning was not used because it was not well correlated with the other strategy variables. The product of these variables was used because we believed that the variables would be mutually supportive and interactive. We expected that when background knowledge was activated, searching would increase substantially, and increased searching would improve organization because a wider range of relevant information would be available in memory.

Scales. From these strategy tasks, the following measures were derived: (a) background knowledge, coded 1–6 to the knowledge rubric; (b) questioning, coded 1–4 to the questioning rubric; (c) searching, number of correctly identified relevant sections in the searching task ranging from 0 to 11; (d) organizing information, a score (coherence) ranging from -1.0 to 1.0 derived from the Pathfinder algorithm; (e) reading comprehension, coded 1–6 to the knowledge rubric (same as the rubric used for background knowledge); (f) passage comprehension, a score ranging from -1.0 to 1.0 derived from the Pathfinder algorithm; and (g) reading motivation, with scores ranging from 4 to 16.

Implementation of Instructional Models

To determine the degree of program implementation, we videotaped two 1-hr lessons provided by each teacher and conducted an interview as the teacher viewed one of the videotapes. Instruction in both CORI and SI was measured in seven instructional practices: (a) knowledge goals for instruction, (b) science integrated with reading, (c) autonomy support, (d) use of interesting texts, (e) collaboration support, (f) self-efficacy support, and (g) SI. These included the five motivational practices in CORI, one motivational practice most relevant for the SI group (self-efficacy support), and one practice in common (SI). For each teacher, a videotape of instruction and an interview based on that videotape were simultaneously coded to describe the extent to which those seven instructional practices appeared. Each practice was rated as follows: 4 (thorough implementation), 3 (partial implementation), 2 (limited implementation), and 1 (no visible implementation). Each teacher received a score of 1–4 for each of the seven instructional practices. Interrater agreement between two independent cod-

ers was examined for each construct. The median correlation was $r(9) = .74, p < .01$; see Table 2.

In addition, an 80-item questionnaire was given to all teachers on the same instructional practices, which included SI, hands-on activities, autonomy support, self-efficacy, knowledge goals, interesting texts, collaborative support, and science-reading integration. The format consisted of statements such as "I frequently provide choices of books in my classroom," with a 4-point response form of 1 = *not at all like me*; 2 = *somewhat like me*; 3 = *quite like me*; and 4 = *a lot like me*. Total scores on the questionnaire had a correlation with the total score on the videotape coding of $r(9) = .67, p < .05$, showing convergent validity for the two measures.

On the basis of the videotape and interview coding, teachers in CORI classrooms were scored higher than SI teachers in the following practices: (a) use of knowledge content goals, (b) hands-on activities related to the knowledge goals, (c) autonomy support for students, and (d) collaboration support for students. For example, CORI teachers utilized knowledge goals in reading instruction at a mean level on the coding rubric that was more than two standard errors higher than the level of implementation for SI teachers. These implementation data showed that four of the five instructional practices in the CORI model were implemented more fully in CORI classrooms than in SI classrooms, using the criterion that the difference between the means on any dimension should be two or more standard errors. A measure of implementation quality for CORI teachers was the sum of the scores for the five motivation practices and SI, and this measure was used as a covariate in the analyses reported later.

Teachers implementing the SI model utilized two instructional practices at a comparable level to CORI teachers: (a) explicit SI and (b) use of interesting texts in reading instruction. SI teachers were marginally higher than CORI teachers on support for self-efficacy because a substantial number of SI teachers perceived that their students gained a sense of empowerment and confidence from learning such strategies as summarizing and that their scaffolding and encouragement had influenced students' sense of efficacy. This suggests that SI teachers were competent and conscientious in attaining their goal of systematically providing explicit SI for students. A measure of the implementation quality for the SI teachers was the score for SI, and this measure was used as a covariate.

On the basis of these implementation quality data, one CORI teacher who had not attended the professional development workshops and who showed low implementation and one SI teacher who was a beginning teacher and who showed equally low implementation were not included in data analyses, leaving 3 CORI teachers and 5 SI teachers for data analysis.

Results

Correlations among variables are presented in Table 3. Data were analyzed at the classroom level because classrooms were the

units assigned to instructional conditions. Correlations between multiple text comprehension and passage comprehension were significant at posttest and at pretest. At posttest, the reading comprehension strategies of background knowledge activation, searching, questioning, and organizing each correlated with multiple text comprehension significantly. A composite of strategies at posttest correlated significantly with multiple text comprehension and passage comprehension. Motivation at posttest correlated significantly with multiple text comprehension, passage comprehension, and the strategy composite.

To examine the effects of instructional conditions on reading outcomes, we analyzed the pretest and posttest scores separately at the classroom level with a procedure similar to that reported by Williams and colleagues (2002) for classroom-based reading comprehension intervention instructional research. That is, when pretest scores for different groups were found to be not significantly different, posttest scores were analyzed. For the dependent variable of multiple text comprehension, we conducted a one-way analysis of covariance with instruction as the independent variable (CORI-SI), multiple text comprehension as the dependent variable, and implementation quality as the covariate. The alpha of .05 was set as a comparisonwise error rate because each comparison was a planned test (Hays, 1988) of a "conceptually distinct question" (Maxwell & Delaney, 1990, p. 259).

A covariate to control for previous or concurrently measured variables was used in analyzing for treatment effects. Pedhazur and Schmelkin (1991) stated, "in many research situations the proxy variable is measured concurrently with the treatment administration or even after the treatment has been administered" (p. 289). The specific rationale for using a covariate in the analysis of the comparison of the effects of CORI and SI on reading comprehension and other outcomes was as follows. The teachers providing the CORI and SI programs each showed individual differences in instructional implementation, even though the lowest teacher in each group was dropped. Within CORI and within SI, some teachers were more effective than others. These individual differences in implementation were correlated with the reading comprehension outcomes. For example, more highly implementing teachers had higher reading comprehension in their classrooms than teachers with lower implementation. The correlation between implementation quality and reading comprehension was $r(9) = .64, p = .06$. Accounting for these differences would be likely to

Table 2
Implementation Characteristics of Teachers in Study 1

Instructional practice	CORI			SI			Total			Interrater agreement
	<i>M</i>	<i>SD</i>	<i>SEM</i>	<i>M</i>	<i>SD</i>	<i>SEM</i>	<i>M</i>	<i>SD</i>	<i>SEM</i>	
Using knowledge goals	3.00	0.00	.00	2.33	0.52	.21	2.56	0.53	.18	.74**
Autonomy support	2.33	0.58	.33	1.67	0.52	.21	1.89	0.60	.20	.82**
Collaboration support	2.33	1.15	.67	1.50	0.55	.22	1.78	0.83	.28	.67*
Hands-on science	3.00	0.00	.00	1.67	0.52	.21	2.11	0.78	.26	.78**
Interesting texts	2.33	1.15	.67	2.33	0.52	.21	2.33	0.71	.24	.65*
Strategy instruction	3.00	0.00	.00	2.83	0.75	.31	2.89	0.60	.20	.67*
Self-efficacy support	2.33	0.58	.33	2.50	0.55	.22	2.44	0.53	.18	.87**

Note. Number of standard errors: Using knowledge goals = 3.70; Autonomy support = 3.30; Collaboration support = 2.96; Hands-on science = 5.10; Interesting texts = 0.00; Strategy instruction = 0.85; Self-efficacy = 0.94. CORI = Concept-Oriented Reading Instruction; SI = strategy instruction.

* $p < .05$. ** $p < .01$.

Table 3
Correlations of Variables in Study 1

Variable	1	2	3	4	5	6	7	8
1. Multiple text comprehension	—	.82**	.92**	.84**	.82**	.70*	.96**	.76*
2. Passage comprehension	.68*	—	.86**	.50	.93**	.47	.84*	.82**
3. Activating background knowledge	.86**	.56	—	.71*	.85**	.66	.98**	.77*
4. Searching	.71*	.68*	.87**	—	.61	.49	.77**	.58
5. Organizing	.64	.90**	.37	.56	—	.50	.84**	.72**
6. Questioning	.48	.33	.23	.13	.46	—	.71**	.69*
7. Strategy composite	.86**	.86**	.70**	.69**	.83**	.62	—	.82**
8. Motivation composite	.55	.24	.51	.29	.44	.52	.51	—

Note. Upper right half of the table shows posttest in December; lower left of the table shows pretest in September.

* $p < .05$. ** $p < .01$.

improve the comparison of CORI and SI by reducing the variance within each of them. One statistical caution is that the covariate in an analysis such as this should not correlate with the treatment variable (Maxwell & Delaney, 1990; Pedhazur & Schmelkin, 1991), which, in this case, it did not, $r(9) = -.07$. In this study, it would have been possible for implementation quality to correlate with the treatment because CORI was a newer and more complex model to the teachers than SI, and plausibly, it may have been more difficult to implement. However, the correlation of treatment and implementation quality was low and not significant. Consequently, this analysis meets the statistical assumptions.

We used this analysis of covariance because each dependent variable was theoretically important, including multiple text comprehension, passage comprehension, strategy composite, and motivation. We did not use multilevel analysis because we were investigating treatment effects at the classroom level (Level 2) and not student-level effects (e.g., demographic characteristics—Level 1), and treatment groups did not differ at pretest on multiple text comprehension (Level 1) variables (Byrk, Raudenbush, & Cong-

don, 1996). We did not have reason to form latent variables that could be examined in structural equation modeling (Bollen, 1989).

There were no significant differences on any of the major pretest measures, including multiple text comprehension, passage comprehension, strategy composite, and motivation (see Table 4). To analyze posttest data, we conducted analyses of covariance on each of these variables with the reading outcome as the dependent variable, instructional condition as the independent variable, and the quality of program implementation as the covariate (see Table 5). Effect sizes were computed using the pooled sample standard deviation of the posttests because that was the time of comparison (Hedges & Olkin, 1985). On the posttest of multiple text comprehension, CORI ($M = 3.65$) was significantly higher than SI ($M = 2.87$), with an effect size of 1.01. On the posttest of passage comprehension, CORI ($M = 0.56$) was significantly higher than SI ($M = 0.31$), with an effect size of 1.32. When the contribution of implementation quality to multiple text comprehension was controlled, CORI had a significant advantage over SI. It is noteworthy that the standard error of measurement of the CORI group in

Table 4
Means and Standard Deviations of Variables in Study 1

Measure	CORI		SI		Total	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Pretest						
Multiple text comprehension	3.13	1.10	2.19	0.78	2.50	0.95
Passage comprehension	0.31	0.18	0.15	0.15	0.20	0.17
Strategy composite	2.63	3.15	1.08	1.11	1.60	1.96
Motivation composite	11.93	1.12	12.17	0.91	12.09	0.92
Background knowledge	2.41	0.60	1.69	0.40	1.93	0.57
Questioning	12.33	1.77	7.12	1.95	8.85	3.15
Searching	3.13	1.49	3.48	1.06	3.37	1.13
Organizing	0.25	0.18	0.17	0.16	0.19	0.16
Posttest						
Multiple text comprehension	3.65	1.04	2.87	0.51	3.13	0.77
Passage comprehension	0.56	0.14	0.31	0.16	0.40	0.19
Strategy composite	7.72	6.14	2.41	1.80	4.18	4.30
Motivation composite	14.50	0.96	13.71	0.66	13.98	0.81
Background knowledge	2.22	0.62	1.67	0.24	1.85	0.46
Questioning	11.70	3.95	10.96	1.16	11.21	2.21
Searching	4.96	1.67	4.38	1.23	4.57	1.31
Organizing	0.58	0.15	0.29	0.19	0.39	0.22

Note. CORI = Concept-Oriented Reading Instruction; SI = strategy instruction.

Table 5
Comparing Effects of CORI and SI on Reading Comprehension, Reading Strategies, and Reading Motivation in Study 1

Dependent variable	Independent variable	<i>F</i>	<i>df</i>	<i>p</i> <	Effect size
Pretest					
Multiple text comprehension	CORI–SI	2.25	(1, 7)	<i>ns</i>	
Passage comprehension	CORI–SI	2.17	(1, 7)	<i>ns</i>	
Strategy composite	CORI–SI	1.28	(1, 7)	<i>ns</i>	
Motivation composite	CORI–SI	0.12	(1, 6)	<i>ns</i>	
Activating background knowledge	CORI–SI	4.86	(1, 7)	<i>ns</i>	
Questioning	CORI–SI	15.06	(1, 7)	.01	
Searching	CORI–SI	0.17	(1, 7)	<i>ns</i>	
Organizing	CORI–SI	0.45	(1, 7)	<i>ns</i>	
Posttest					
Multiple text comprehension	CORI–SI	6.31	(1, 6)	.05	1.01
Passage comprehension	CORI–SI	8.11	(1, 6)	.03	1.32
Strategy composite	CORI–SI	6.74	(1, 6)	.04	1.23
Motivation composite	CORI–SI	12.17	(1, 6)	.02	0.98
Activating background knowledge	CORI–SI	4.99	(1, 6)	<i>ns</i>	1.20
Questioning	CORI–SI	0.35	(1, 6)	<i>ns</i>	0.33
Searching	CORI–SI	1.35	(1, 6)	<i>ns</i>	0.44
Organizing	CORI–SI	6.03	(1, 6)	.05	1.32

Note. CORI = Concept-Oriented Reading Instruction; SI = strategy instruction.

reading comprehension without the covariate was .41, whereas the standard error of measurement of the CORI group with the covariate included was .27, showing a clear decrease. The standard error of measurement of the SI group in reading comprehension without the covariate was .29, whereas the standard error of measurement of the SI group with the covariate included was .19, showing a clear decrease. Thus, the analysis of covariance reduced the within-group variance for both CORI and SI, although this analysis did not adjust the means appreciably.

In the analysis of covariance on the posttest measure of the comprehension strategy composite, CORI ($M = 7.72$) was significantly higher than SI ($M = 1.80$), with an effect size of 1.23. In the analysis of covariance on the posttest measure of reading motivation composite, CORI ($M = 14.50$) was significantly higher than SI ($M = 13.71$), with an effect size of 0.98. On the posttests of activating background knowledge, questioning, and searching, the analysis of covariance showed no significant differences between instructional conditions. In sum, CORI was higher at posttest than SI on multiple text comprehension, passage comprehension, the reading strategy composite, and the reading motivation composite, although CORI and SI were not significantly different on these variables on the pretests.

Study 2

Method

Background and Rationale

The rationale for Study 2 was nearly identical to that of Study 1, emphasizing a comparison of CORI and SI on variables of reading comprehension, reading strategies, and reading motivation. The instructional interventions were provided by many of the same teachers in their second year of program implementation. In addition, Study 2 included a comparison group consisting of TI, in which no intervention was included. The district recommended this school as likely to participate. A standardized reading comprehension measure, the Gates-MacGinitie Reading Compre-

hension Test (MacGinitie et al., 2000), was administered as a posttest to see if instructional effects extended to this variable. To use a variety of motivation measures in the research, we measured student motivation with teacher ratings rather than the MRQ self-report measure.

Participants

Demographic characteristics of the children in the sample for Study 2 are presented in Table 6. Chi-square tests indicated that the instructional groups did not differ on these demographic characteristics except for ethnicity. The CORI and SI schools had more ethnic minority children than the TI school. There were 9 CORI, 11 SI, and 4 TI classrooms.

Design and Procedure

As in Study 1, we used an equivalent groups pretest–posttest design (Pedhazur & Schmelkin, 1991). CORI was implemented in two schools, to all third-grade students in nine classrooms. Because of moves and illness, 4 teachers were new, and 5 teachers were the same as Study 1. SI was implemented with all students in 11 classrooms of two schools; 9 teachers were the same as Study 1, and 2 were new. TI was provided in four Grade 3 classrooms in one school. Characteristics of the 10 teachers new to the study were as follows: Age ranges were 4 teachers in the 21–30-year-old range, 5 teachers in the 31–45-year-old range, and 1 teacher in the 46–60-year-old range. Years of teaching experience were 4 teachers having 0–3 years of experience, 5 teachers having 4–10 years, and 1 teacher having 11 or more years. Nine teachers were female, and 1 teacher was male. Eight teachers were Caucasian, and 2 teachers were African American. Program structure for CORI and SI classes was quite similar to Study 1 in terms of duration of instruction and content covered. CORI, SI, and TI were provided in 90-min lessons daily for 12 weeks from the second week in September to the second week in December.

Instructional Frameworks

The CORI and SI instructional frameworks were the same in Study 2 as in Study 1. The reading comprehension strategies were identical, and the motivational practices were the same. However, in Study 2, a plan for instructing struggling readers was implemented in CORI classrooms. For

Table 6
Demographic Characteristics of Students in Study 2

Characteristic	CORI		SI		TI	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Sex						
Male	108	57	129	50	42	55
Female	83	43	128	50	34	45
Total	191		257		76	
Ethnicity						
Caucasian	106	59	138	56	53	90
Minority	94	41	109	44	6	10
Total	180		247		59	
ELL						
Yes	4	2	7	3	0	0
No	191	98	253	97	83	100
Total	195		260		83	
Special education						
Yes	29	16	26	11	12	20
No	155	84	222	89	47	80
Total	184		248		59	

Note. CORI = Concept-Oriented Reading Instruction; SI = strategy instruction; TI = traditional instruction; ELL = English language learners.

30 min daily, students identified by the teacher as substantially lower achieving than others in the class were given instruction focusing on fluency development and simplified SI consistent with the conceptual theme. In some classrooms, these students were pulled out by a special education teacher, and in other classrooms, the regular teacher provided instruction (Guthrie, 2004). Instruction for struggling readers was emphasized in SI classrooms in ways that were comparable to the approach used in CORI. In-classroom differentiated teaching and pullout for special education were provided for all such students as appropriate.

TI consisted of an extensive amount of text interaction with a variety of basal materials and trade books. Strategies such as predicting and activating background knowledge were taught implicitly as appropriate to the text. Struggling readers were given appropriately differentiated instruction and reading materials.

Books for Instruction

The books provided to CORI teachers were nearly identical to those used in Study 1. For struggling readers, books for fluency development were provided to CORI teachers. They were easily decodable and lent themselves to expressive reading (Kuhn & Stahl, 2003). Some specific books in the team sets were substituted to accommodate the students' reading levels more fully. SI and TI teachers used reading materials available to them in their schools.

Science

Science activities in CORI were the same as in Study 1, with identical themes and science processes. The aquatic experiments were fine tuned with more explicit charts and guides for student journaling (Barbosa & Alexander, 2004).

Measures

Assessments consisted of a pretest the first week of September and a posttest the third week of December. In 24 classrooms (9 CORI, 11 SI, and 4 TI), students completed the passage comprehension task similar to that of Study 1 and the Gates-MacGinitie Reading Comprehension Test (MacGinitie et al., 2000). In Study 2, the passage comprehension assessment consisted of four alternative forms based on the topic of the reading

passage (bat, bear, shark, or snake), which were randomly assigned to classrooms. In this assessment, students read a passage of 550 words on one of the topics (bat, bear, shark, or snake) and completed the ratings of word pairs of 9 key words on the computer. We included the Gates-MacGinitie Level 3 Form S, which requires 50 min, so as to have a standardized reading test as part of our assessment.

To examine whether the motivation effects in Study 1 generalized to teachers' perception of students' motivation, we asked CORI and SI teachers to rate their students' self-efficacy for reading, intrinsic motivation to read, and extrinsic motivation to read. Teachers did these ratings in January following the completion of the interventions, as part of an end-of-intervention professional development workshop that CORI and SI teachers attended. TI teachers did not participate in this workshop and so did not complete the student motivation ratings. CORI and SI teachers were given definitions of each of the motivation terms. On a 1 to 5 scale, teachers rated the extent to which each of their students possessed each motivational characteristic. Intrinsic motivation was defined as curiosity and interest in reading frequently for its own sake. Extrinsic motivation was defined as reading for recognition, for rewards, to be the best, or to outperform classmates. Self-efficacy in reading was defined as having confidence in reading, taking sensible risks, and reading challenging material.

The rationale for using the teacher ratings was generalizability. Although Study 1 showed that CORI increased motivation compared with SI on a self-reported measure and although reading comprehension is known to correlate with self-reported motivation (Gottfried, 1985, 1990), a self-report is subject to social desirability and ceiling effects. Furthermore, we believe it is valuable to use multiple indicators of motivation, including teacher perception (Sweet et al., 1998). Note that teacher ratings of intrinsic motivation correlated with passage comprehension in Study 2, $r(12) = .75$, $p < .01$, at a comparable level to students' self-reported motivation and passage comprehension in Study 1, $r(9) = .82$, $p < .01$. We wanted to investigate whether the effects of CORI on motivation in Study 1 would be confirmed with a different measure of motivation constructs.

Implementation of Instructional Models

An analysis of implementation quality was conducted with a procedure nearly identical to that of Study 1. One lesson was videotaped, and a semistructured interview was conducted as the teacher viewed the videotape. Eight instructional practices were coded for degree of presence and prominence in the videotape: (a) knowledge goals for instruction, (b) science integrated with reading, (c) autonomy support, (d) use of interesting texts, (e) collaboration support, (f) self-efficacy support, (g) SI, and (h) program control. The eighth practice, program control, was added to Study 2. This practice represents the use of basal materials and the instructional activities suggested in the basal. TI teachers used basal stories and texts, occasionally supplementing them with a trade book. Writing activities recommended in the basal were followed, and guided reading was frequently provided. CORI teachers received a low score on the subscale. With a criterion of two or more standard errors of each dimension on this rubric, CORI teachers scored higher than SI and TI in implementation of the following: (a) use of knowledge goals in reading instruction, (b) integration of science with reading, (c) autonomy support for students, (d) collaboration support, and (e) self-efficacy support. CORI teachers rated the same as SI teachers on SI, and both scored higher than TI teachers on SI. CORI and SI were not rated differently in the use of interesting texts, and CORI scored lower than TI in the use of interesting texts. We expect that this was due to the fact that TI teachers had many more narrative, literary texts than CORI and that teachers tend to assess literary texts as more enjoyable and interesting than information texts. CORI ranked lower than SI and TI in the use of program control of instruction, and SI and TI were rated similarly in this practice (see Table 7).

In sum, CORI teachers scored higher than SI and TI teachers on four of the five instructional practices that define the CORI framework, including knowledge content goals, science integration, autonomy support, and col-

Table 7
Implementation Characteristics of CORI, SI, and TI Teachers in Study 2

Instructional practices	CORI		SI		TI		Total SEM
	M	SD	M	SD	M	SD	
Knowledge goals	3.11	0.60	2.00	0.67	2.00	0.82	.18
Autonomy support	2.67	1.00	1.80	0.63	2.25	1.50	.21
Collaboration support	2.78	0.83	2.00	0.94	1.50	0.58	.20
Science integration	2.22	1.09	1.50	0.71	1.50	0.58	.19
Interesting texts	2.67	0.87	2.70	0.48	3.00	0.00	.13
Strategy instruction	3.44	0.73	3.20	0.63	2.50	0.58	.15
Self-efficacy support	2.67	0.50	2.30	0.82	2.25	0.96	.15
Program control	1.00	0.00	2.30	1.16	2.00	1.41	.23

Note. CORI = Concept-Oriented Reading Instruction; SI = strategy instruction; TI = traditional instruction.

laboration support. They were not ranked differently from SI teachers and were assessed lower than TI teachers on use of interesting texts. From these data, we infer that CORI teachers implemented the CORI framework in a clear, effective fashion that distinguished them from comparison teachers.

The SI teachers rated equal to CORI teachers and scored higher than TI teachers in implementing SI. SI teachers scored higher than CORI teachers and rated equal to TI teachers in using program control in the classroom. This confirmed that SI teachers implemented the SI model thoroughly and effectively. These findings, reflecting practices of CORI and SI teachers, are highly similar to the implementation findings of Study 1. In Study 2, the only difference is that CORI scored higher than SI in support for self-efficacy, whereas the groups were not rated differently on this instructional practice in Study 1. On the basis of these data, scores for two CORI and two SI classrooms were not used in the analysis because of limited implementation. To form instructional groups that were equivalent on the passage comprehension pretest, we dropped the two lowest scoring CORI and SI classes and the highest scoring TI class on the pretest. For analysis, five CORI, seven SI, and three TI classrooms were used. We did not use analysis of covariance because we did not have the Gates-MacGinitie pretest to compare with the posttest, so we used an analysis (equivalent groups pretest–posttest) similar to Study 1 for consistency.

Results

Correlations among variables are presented in Table 8. Because of aggregation at the classroom level, correlations are substantial. Passage comprehension and Gates-MacGinitie comprehension subtest were correlated, $r(15) = .82, p < .001$. Passage comprehension in pretest and posttest was correlated, $r(15) = .62, p < .01$. Teachers’ ratings of students’ intrinsic motivation correlated with passage comprehension, $r(12) = .75, p < .01$, and with Gates-MacGinitie, $r(12) = .88, p < .01$, and their ratings of

student self-efficacy correlated significantly with passage comprehension, $r(12) = .75, p < .01$, and with Gates-MacGinitie, $r(12) = .81, p < .01$. Teachers’ ratings of students’ extrinsic motivation did not correlate significantly with either reading comprehension measure.

To analyze the reading comprehension outcomes of passage comprehension and Gates-MacGinitie, we conducted analyses of covariance at the class level with instructional condition as the independent variable, the reading comprehension measures as the dependent variables, and student diversity as the covariate. Because all comparisons of instructional groups were theoretically significant (e.g., CORI–SI, CORI–TI, SI–TI), separate analyses of variance were constructed. The CORI and SI schools had a higher proportion of minority students than the TI school (see Table 6), which presented challenges to teachers in differentiating instruction, locating appropriate materials, and managing classrooms. We, therefore, chose to use this variable as the covariate in Study 2 for comparisons with TI, and it was statistically significant. No covariate was used for comparisons of CORI and SI because the groups were similar on this variable.

Means and standard deviations from the analysis of covariance are presented in Table 9, and the effects from the analysis are presented in Table 10. At pretest, CORI, SI, and TI were not significantly different on the passage comprehension pretest. On the passage comprehension posttest, CORI ($M = 0.46$) was significantly higher than TI ($M = 0.35$). CORI was not significantly different from SI ($M = 0.38$), and TI and SI were not significantly different from each other. On the extended scale scores of the Gates-MacGinitie comprehension test, the analysis showed that

Table 8
Correlations Among Variables in Study 2

Variable	1	2	3	4	5	6
1. Passage comprehension (posttest)	—					
2. Gates-MacGinitie Reading Comprehension Test	.82**	—				
3. Passage comprehension (pretest)	.62*	.42	—			
4. Intrinsic motivation	.75**	.88**	.34	—		
5. Self-efficacy	.75**	.81**	.59*	.77**	—	
6. Extrinsic motivation	.50	.49	.30	.70*	.67*	—

* $p < .05$. ** $p < .01$.

Table 9
Means and Standard Deviations of Variables in Study 2

Variable	CORI		SI		TI		Total		N
	M	SD	M	SD	M	SD	M	SD	
Passage comprehension (pretest)	0.33	0.11	0.32	0.074	0.32	0.049	0.33	0.079	15
Passage comprehension (posttest)	0.46	0.098	0.38	0.054	0.35	0.040	0.40	0.080	15
Gates-MacGinitie Reading Comprehension Test	498.60	22.57	468.57	15.85	483.33	11.93	481.53	21.50	15
Intrinsic motivation	4.36	0.36	3.67	0.51			3.96	0.056	12
Self-efficacy	4.52	0.61	3.80	0.65			4.01	0.76	12
Extrinsic motivation	4.52	0.38	3.64	0.70			4.10	0.68	12
Combined motivations	13.40	0.86	11.11	1.69			12.07	1.79	12
Gates-MacGinitie Reading Comprehension Test grade equivalent	5.26	1.67	3.80	0.83	4.30	0.52	4.39	1.26	15

Note. CORI = Concept-Oriented Reading Instruction; SI = strategy instruction; TI = traditional instruction.

CORI ($M = 498.60$) was significantly higher than SI ($M = 468.57$) and that CORI was significantly higher than TI ($M = 483.33$).

In the analysis of students' motivation (a measure given only at posttest), CORI teachers rated their students' intrinsic motivation to read higher than did the SI teachers (CORI $M = 4.36$; SI $M = 3.67$), with an effect size of 1.23. On the self-efficacy ratings, CORI and SI students did not differ. On the measure of extrinsic motivation, CORI ($M = 4.52$) was significantly higher than SI ($M = 3.64$), with an effect size of 1.29. Intrinsic and extrinsic reading motivations are often highly correlated (Wigfield & Guthrie, 1997), and it is not surprising that CORI students scored relatively high in both. A composite motivation variable consisting of the sum of intrinsic motivation, self-efficacy, and extrinsic motivation ratings was also formed. Scores on these three items were summed to form a general motivation score to compare CORI and SI on a more inclusive motivation measure. On this measure, CORI ($M = 13.40$) was significantly higher than SI ($M = 11.11$), with an effect size of 1.28.

In sum, in Study 2, at posttest, CORI students showed higher passage reading comprehension than TI students even though there were no differences between these groups on this measure at pretest. CORI students performed better than SI and TI students on

the Gates-MacGinitie Reading Comprehension Test given at posttest. CORI students surpassed SI students in intrinsic motivation, extrinsic motivation, and a combined motivation measure.

Discussion

To summarize the most important findings, CORI students scored higher than SI students on passage comprehension (Study 1), multiple text comprehension (Study 1), and the standardized test (Study 2). CORI students scored significantly higher than TI students on passage comprehension and the standardized test (Study 2). We found that CORI increased students' self-reported motivation in comparison with SI (Study 1) and that CORI teachers rated their students as more highly motivated to read than did the SI teachers (Study 2). In addition, CORI increased a composite of students' cognitive strategies of activating background knowledge during reading, searching for information in books, and organizing information from reading (Study 1). Thus, overall, CORI students were more motivated than SI and TI students and were more strategic readers than SI students. In this study, the measures of reading engagement were limited to students' comprehension strategies and motivation.

Table 10
Comparing Effects of CORI, SI, and TI on Reading Comprehension and Reading Motivation in Study 2

Dependent variable	Independent variable	F	df	p <	Effect size
Passage comprehension (pretest)	CORI-SI-TI	0.37	(2, 9)	ns	
Passage comprehension (posttest)	CORI-TI	10.22	(1, 4)	.03	2.75
Passage comprehension (posttest)	CORI-SI	1.78	(1, 7)	ns	1.48
Passage comprehension (posttest)	SI-TI	0.88	(1, 6)	ns	0.75
Gates-MacGinitie Reading Comprehension Test (posttest)	CORI-TI	8.69	(1, 4)	.04	0.71
Gates-MacGinitie Reading Comprehension Test (posttest)	CORI-SI	5.56	(1, 7)	.05	1.40
Gates-MacGinitie Reading Comprehension Test (posttest)	SI-TI	8.45	(1, 6)	.03	0.69
Intrinsic motivation	CORI-SI	6.63	(1, 10)	.03	1.23
Self-efficacy	CORI-SI	4.29	(1, 10)	ns	0.95
Extrinsic motivation	CORI-SI	5.55	(1, 10)	.04	1.29
Motivations combined	CORI-SI	7.60	(1, 10)	.02	1.28

Note. CORI = Concept-Oriented Reading Instruction; SI = strategy instruction; TI = traditional instruction.

The importance of these results to the literature on reading comprehension instruction is threefold. First, the knowledge base of reading comprehension instruction is largely derived from investigations of single strategies in controlled studies (National Reading Panel, 2000), and long-term, multiple strategy teaching needs to be investigated (Block & Pressley, 2002; National Reading Panel, 2000; Snow, 2002). Second, motivation and engagement in reading correlate highly with reading comprehension; they are needed for strategy development (Guthrie et al., 1999). Yet, instructional practices to support reading motivation and engagement have not been sufficiently investigated in classroom settings (Sweet & Snow, 2003). Third, motivational practices for reading in the classroom have been studied qualitatively (Dolezal et al., 2003) and observationally (Stipek, 2002) but have rarely been examined experimentally in classroom contexts as they were here. Our findings contribute to the knowledge base on reading comprehension instruction by showing experimentally that explicitly combining motivation practices with SI increases reading comprehension relative to SI alone or to TI.

The design of this study was hierarchical. In TI, teachers implemented guided reading with basal and trade books, and they attempted to assure ample text interaction for students. The SI model combined strategy learning with the text interaction of TI. SI consisted of teaching six comprehension strategies, with materials and text interactions very similar to those used in TI. The CORI model provided motivational support in addition to SI and the text interaction of TI. Given the hierarchical design of the study, the explanation of the results is based on a comparison of those instructional practices. CORI had two broad sets of practices, motivation support and SI, whereas SI had strategy-instructional practices only. As CORI students were assessed higher than SI on reading comprehension, we infer that combining motivational and strategy support had an advantage over strategy support only. We attribute the difference in reading comprehension outcomes in the CORI and SI groups to the different instructional practices in those groups. Similarly, the advantage of CORI over SI in strategies and motivation is attributed to differences in instructional practices. Likewise, the advantage of CORI over TI in reading comprehension is due to differences of CORI and TI in instructional practices.

This study did not attempt to distinguish whether the motivation practices had a direct effect on reading comprehension or whether motivation practices interacted with SI practices to produce the CORI effects. Such a distinction requires a $2 \times 2 \times 2$ factorial design with a no-treatment control receiving no instruction and no text that is not feasible in a long-term, school-based instructional study. However, it is evident that without the motivation-supporting practices, SI students scored lower than CORI students on outcomes of reading comprehension, reading motivation, and reading strategies, and that TI students scored lower than CORI students on reading comprehension.

One might question why CORI appeared to increase reading comprehension. We believe that CORI motivational practices are likely to have multiple cognitive as well as motivational benefits for students. For instance, the practice of using content goals for reading instruction is motivating because such goals provide fascinating topics for reading (e.g., animal competition and survival in harsh environments). As such, these topics provide mastery goals for students and thereby increase interest and motivation (Wigfield & Tonks, 2004). Simultaneously, such content goals in a conceptual theme provide a rich substantive domain in which to

learn strategies. Previous studies have suggested that rich knowledge domains improve cognitive strategy learning (Pressley et al., 1992), and it is possible that the conceptual theme in CORI generates conceptual learning and strategy development, as well as motivation for reading, both of which contribute to comprehension.

Hands-on activities are recommended by teachers and teacher educators as ways to increase student motivation (Zahorik, 1996) and are consistent with recommendations from motivation theory that students need opportunities for active learning (Stipek, 2002). Such practices also have been suggested to lead to increased cognitive processing in the form of attention, questioning, and hypothesizing (Ross, 1988). Although one experimental study (Swan, 2003) showed that hands-on activity interacted with interesting texts to increase reading comprehension, such investigations are rare.

Likewise, we suggest that teachers' support for students' choices are motivating within the CORI context, and previous studies have verified the motivational benefit of autonomy support in reading (see Guthrie & Humenick, in press, for review). However, the process of choosing a book may also have conceptual benefits. Students may think about what they know about a topic and select a book that will be reasonably familiar yet also informative. Under these conditions, students may learn new knowledge more deeply than they would if books were selected for them. In addition, students often use effort-demanding cognitive strategies, such as summarizing, if they are reading a personally chosen book, and consequently, they may practice their reading strategies more effectively in self-selected reading than in other types of reading.

Interesting texts also provide mutual cognitive and motivational benefits (Schiefele, 1999). When students are interested in what they read, they process the material more deeply, gain richer conceptual understandings, and engage more fully with the text. CORI teachers were provided numerous texts that were tied to the conceptual theme of the CORI units and that were selected because of text features thought to be interesting to students. However, our analyses of implementation quality did not find differences favoring CORI in the use of interesting texts. CORI teachers viewed their texts as less interesting than SI or TI teachers. Therefore, we are cautious about attributing effects to this variable. Finally, collaboration with other students has been shown to have both cognitive and motivational benefits for students (Webb & Palincsar, 1996).

On the basis of these findings from the research literature and from this study, we suggest the possibility that motivational practices are likely to have positive effects on students' conceptual knowledge acquisition and strategic development as well as on their motivational dispositions and behaviors. Furthermore, the motivational practices likely interact in complex ways with the SI practices in producing the observed effects. For instance, when students are more motivated to read, they may attend better to SI and master the strategies more fully, thereby comprehending better. Therefore, our attribution for the effects of CORI and the motivational practices within CORI is not restricted to the motivational responses of students to CORI. Students' growth in topic knowledge and their application of strategies to aid their learning may also be increased, which would represent cognitive rather than only motivational changes. In other words, the motivational practices may influence all aspects of engaged reading measured in this

study. The claim forwarded here is that the motivational practices within CORI are responsible for the improvements in students' motivation, reading comprehension, and cognitive strategy use, through the multiple effects described previously.

Motivational practices used in CORI are consistent with the recommendations of motivation theorists such as Ames (1992) and Stipek (2002), who proposed using a limited set of several practices to enhance student motivation. On one hand, we believe that generalized, long-term reading motivation is not likely to be substantially increased by a single, focused motivational practice in the classroom, such as providing challenging tasks (Meece & Miller, 1999) or instructional conversations (Saunders & Goldenberg, 1999). On the other hand, it seems likely that the 25–30 instructional practices typical of outstanding teachers who have highly engaged students (Bogner et al., 2002) may not all be necessary for increasing the level of engagement of a majority of the students. Consequently, we suggest that a finite set of instructional supports explicitly targeted to motivational development in reading can facilitate engaged reading and reading comprehension. The motivation-supporting practices included in this investigation (content goals in a conceptual theme for reading instruction, hands-on activities, students' choices, interesting texts for instruction, and collaboration in reading) are one set of classroom enactments that provide added value for reading engagement when combined with SI and text interaction. Other possible practices could be added to this list. However, given the results of this study, we believe these practices provide sufficient support for student motivation (see Guthrie & Alao, 1997, for discussion of necessary and sufficient conditions for fostering students' reading motivation).

Although it may be possible to isolate the effects of these different instructional practices in experimental studies, we believe that in classroom settings, these practices depend on each other to some degree. For example, autonomy support requires a context because a teacher cannot give choices in a vacuum. Topics, texts, writing activities, groups of students, and other features of the classroom must be present to enable the teacher to afford choices to students during reading instruction. Therefore, because of their mutual dependencies, it seems neither feasible nor possible to focus on implementing just one or two of these practices in an actual classroom setting. Whether there are other sets of practices that are valuable and whether a smaller set of two to three practices is equally effective in enhancing reading engagement and comprehension remain to be observed in future research.

This investigation has limitations that should be mentioned. The number of classrooms included in these studies provided sufficient power to conduct our analyses at the classroom level, but a larger number of classrooms would have been preferable. The studies were done with third graders, and so, we do not know how or whether the findings might generalize to other age groups. We believe it is a strength of the study that different kinds of motivation measures (self-reporting and teacher ratings) were used, but acknowledge that each of these types of measures provides a limited sense of students' motivation. Other kinds of motivational measures and measures of engagement, such as classroom observations, should be included in future studies. Many of the reading comprehension measures focused on science, which was appropriate given that all classrooms studied this content area and the particular topics in it. However, we do not know if CORI's effects extend to other content areas, although results of a previous study

on CORI suggest that they do (Guthrie et al., 1999). Finally, the research design did not permit us to determine precisely which aspects of the CORI treatment produced the effects favoring CORI students. As noted earlier, we do not think it would be meaningful to isolate each individual aspect of the CORI program, but perhaps different combinations of the motivation support and strategy-instructional practices could be examined.

An additional limitation is that the conclusions must be qualified because of the complexity of a field experiment. We have focused on the role of the motivational support practices and their multiple effects on motivational and cognitive outcomes as the primary explanation for the findings. What other explanations for these results may be possible? In complex field-based studies, many variables might affect the results; these include differences in the makeup of the treatment groups, unmeasured aspects of the treatments, differences in teacher training across groups, differences in the curriculum in the classrooms, and differences in services for low-achieving students. We attempted to control for all of these variables in this investigation. We were obliged to drop some teachers because of low implementation and were unable to obtain some data (e.g., motivation ratings for TI teachers). The samples in the different groups were selected to be as equivalent as possible, and when they were not (the TI group in Study 2), appropriate statistical controls were added to the analyses. The CORI, SI, and TI treatments were implemented in the context of the same science units in the district's curriculum. In Study 2, a struggling readers strand was developed for CORI to differentiate instruction in CORI as fully as it was in SI and TI. Finally, CORI and SI teachers received nearly identical training in the SI aspect of the instructional program, and each group had similar amounts of planning time built into their training. The additional time CORI teachers spent in the teachers' workshops was spent on the motivation support practices and in learning various science activities to build into their science units. Despite this comparability, we believe that our conclusions should be viewed with caution and that replication is important in this kind of research.

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(Appendixes follow)

Appendix A

Summary of Concept-Oriented Reading Instruction Books

Table A1
Types of Books for Concept-Oriented Reading Instruction Themes

Book types	Birds around the world	Survival in freshwater habitats
Class sets	17	19
Team sets	8	10
Struggling reader	5	5
Individual	27	33

Class Sets

Birds Around the World:

Informational:

- Hewitt, S. (1999). *All kinds of habitats*. Danbury, CT: Children's Press.
- Bailey, J., & Burnie, D. (1992). *Eyewitness explorers: Birds*. New York: DK Publishing.
- Biddulph, F., & Biddulph, J. (1993). *How birds live*. Bothell, WA: Wright Group.
- Swanson, D. (1997). *Welcome to the world of owls*. Vancouver, British Columbia, Canada: Whitecap Books.
- Savage, S. (2000). *What's the difference: Birds*. Austin, TX: Steck-Vaughn.
- Burton, P. (2002). *Usborne spotter's guide: Birds of North America*. Allentown, PA: Usborne Publishing.
- Stokes, D., & Stokes, L. (1996). *Beginner's guide to birds: Eastern region*. Boston: Little, Brown.

Literary:

- Van Frankenhuyzen, R. S. (2001). *Adopted by an owl: The true story of Jackson the owl*. Chelsea, MI: Sleeping Bear Press.
- Yolen, J. (1999). *Bird watch*. New York: Puffin.
- James, S. (2002). *The birdwatchers*. Cambridge, MA: Candlewick Press.
- Lewis, J. P. (2001). *Earth and you: A closer view*. Nevada City, CA: Dawn.
- Fox, M. (2000). *Feathers and fools*. New York: Voyager Books.
- Relf, P. (1995). *The magic school bus: Hops home*. New York: Scholastic.
- Florian, D. (2000). *On the wing*. New York: Voyager Books.
- Fleming, C. (1999). *When Agnes caws*. New York: Atheneum.
- Yolen, J. (1987). *Owl moon*. New York: Philomel Books.

Book Club Novels:

- Costello, E. (1999). *Ducks in danger*. New York: Avon Books.
- Roy, R. (1998). *The falcon's feathers*. New York: Random House.
- George, J. C. (1995). *One day in the woods*. New York: HarperCollins.
- George, J. C. (1997). *There's an owl in the shower*. New York: HarperCollins.
- Bulla, C. R. (1996). *White bird*. New York: Random House.

Survival in Freshwater Habitats:

Informational:

- King, M. (1995). *Animal eaters of the pond*. Bothell, WA: Wright Group.
- Butterfield, M. (2000). *Animals in rivers & lakes*. Austin, TX: Raintree Steck-Vaughn.
- Biddulph, F., & Biddulph, J. (1995). *Plant eaters of the pond*. Bothell, WA: Wright Group.
- King, M. (1995). *The pond*. Bothell, WA: Wright Group.
- Holmes, K. J. (1998). *Snails*. Mankato, MN: Capstone Press.
- Mills, D. (1996). *Aquarium fish*. New York: DK Publishing.
- Reid, G. K. (2001). *Pond life*. New York: St. Martin's Press.

Literary:

- Tagholm, S. (2000). *Animal lives: The frog*. New York: Kingfisher.
- Arnosky, J. (2000). *Beaver pond, moose pond*. Washington, DC: National Geographic Society.
- Goingback, O. (1997). *The gift*. Bothell, WA: Wright Group.
- Florian, D. (1997). *In the swim*. Orlando, FL: Harcourt.
- Lasky, K. (1995). *Pond year*. Cambridge, MA: Candlewick Press.
- Pfister, M. (1995). *The rainbow fish*. New York: North South Books.
- Morpurgo, M. (2000). *The silver swan*. New York: Penguin Putnam.

Book Club Novels:

- Osborne, M. P. (1997). *Afternoon on the Amazon*. New York: Random House.

2. Osborne, M. P. (1997). *Dolphins at daybreak*. New York: Random House.
3. Napoli, D. J. (1997). *Jimmy: The pickpocket of the palace*. New York: Penguin.
4. Park, B. (1998). *Junie B. Jones smells something fishy*. New York: Random House.
5. Napoli, D. J. (1992). *The prince of the pond*. New York: Penguin.

Team Sets

Birds Around the World:

Informational:

1. Arnosky, J. (1999). *All about owls*. New York: Scholastic.
2. Noonan, D. (n.d.). *Bird beaks/bird nests*. Bothell, WA: Wright Group.
3. Hickman, P. (2000). *Bird: Starting with nature*. Niagara Falls, NY: Kids Can Press.
4. Stone, L. M. (1997). *Birds: Desert animals*. Vero Beach, FL: Rourke Enterprises.
5. Davidson, A. (1991). *Birds of a feather*. Crystal Lake, IL: Rigby.
6. Moon, L. (n.d.). *Birds of the city*. Bothell, WA: Wright Group.
7. Ring, S. (1999). *Owls*. New York: Newbridge.
8. Stone, L. M. (1989). *Owls*. Vero Beach, FL: Rourke Enterprises.
9. Miller, S. S. (1999). *Perching birds of North America*. Danbury, CT: Franklin Watts.
10. Stone, L. M. (1993). *Predators: Birds*. Vero Beach, FL: Rourke Enterprises.
11. Biome set: True books

Brimner, L. D. (1997). *Polar mammals*. Danbury, CT: Children's Press.

Stile, D. R. (2000). *Desert*. Danbury, CT: Children's Press.

Stile, D. R. (2000). *Tropical rainforest*. Danbury, CT: Children's Press.

Stile, D. R. (2000). *Grasslands*. Danbury, CT: Children's Press.

Landau, E. (1996). *Temperate forest mammals*. Danbury, CT: Children's Press.

Landau, E. (1997). *Mountain mammals*. Danbury, CT: Children's Press.

Survival in Freshwater Habitats:

Informational:

1. Hibbert, A. (1999). *A freshwater pond*. New York: Crabtree.
2. Clarke, B. (1990). *Amazing frogs and toads*. New York: Knopf.
3. Grimm, P. W. (2000). *Crayfish*. New York: Lerner.
4. Snowball, D. (1994). *Freshwater habitats*. Greenvale, NY: Mondo.
5. Brough, C. (1995). *How snails live*. Bothell, WA: Wright Group.
6. Brough, C. (n.d.). *How snails protect themselves*. Bothell, WA: Wright Group.
7. Brough, C. (1995). *The life cycle of a snail*. Bothell, WA: Wright Group.
8. Kalman, B. (1999). *What is a fish?* New York: Crabtree.
9. Savage, S. (2000). *What's the difference: Amphibians*. Austin, TX: Steck-Vaughn.

Struggling Reader

Birds Around the World:

1. Shirley, A. (1993). *Eggs and baby birds*. Bothell, WA: Wright Group.
2. Biddulph, F., & Biddulph, J. (1993). *Feathers and flight*. Bothell, WA: Wright Group.
3. Fowler, A. (1999). *It could still be a bird*. Danbury, CT: Children's Press.
4. Lobel, A. (1975). *Owl at home*. New York: Harper & Row.
5. Waddell, M. (1992). *Owl babies*. Cambridge, MA: Candlewick Press.

Survival in Freshwater Habitats:

1. Lobel, A. (1979). *Days with frog and toad*. New York: HarperCollins.
2. Taylor, K. (1998). *Frog: See how they grow*. New York: Penguin Books.
3. Fowler, A. (1992). *Frogs and toads and tadpoles too*. Chicago: Children's Press.
4. Pfeffer, W. (1994). *From tadpole to frog*. New York: HarperCollins.
5. Fowler, A. (1996). *Life in a pond*. New York: Children's Press.

(Appendixes continue)

Appendix B

Rubric for Students' Written Responses for Reading Comprehension
and Background Knowledge

Facts and Associations—Simple

Level 1

Students present a few characteristics of a biome or an organism.
Example: In grasslands are lions, tigers, zebras.

Example: Some snakes, which live in the desert, squeeze their prey to death and then eat them. This is called a deadly hug. Bright markings on some snakes are warnings to stay away. In the desert two male jackrabbits fight for a female. Some deserts are actually cold and rocky. Both deserts' hot or cold, it barely ever rain and if it does it comes down so fast and so hard it just runs off and does not sink into the ground.

Facts and Associations—Extended

Level 2

Students correctly classify several organisms, often in lists, with limited definitions.

Example: Animals live in a desert. They like to live there because it's nice and warm. Ducks like to drink water in the pond. They are different because one of them is wet and the other dry. Snake and bears, birds, live in the deserts. They help each other live by giving the animals water and some food that's what the mothers do.

Concepts and Evidence—Simple

Level 3

Students present well-formed definitions of biomes with many organisms correctly classified, accompanied by one or two simple concepts with minimal supporting evidence.

Example: Deserts are different than ponds because deserts have a little bit of water and ponds have a lot of water. The animals that live in a pond are snakes, fish, bugs, ducks, and plants. The plants that live in a pond are grass and seaweed. The animals and plants that live in a desert are rattlesnakes, foxes, rabbits, owls, woodpeckers. The plants that live in a desert are cactus, little grass, small trees. Some of the animals eat plants. The plants eat the food in the soil and the little rain. The animals help the plants live by when the animals step on the ground it makes it a little soft and it is easy for the plants to grow. The plants help the animals by bringing some animals close so other animals can catch them and eat them. The animals also help the plant when some of the bugs that drink the plants nectar carry things from one plant to another.

Concepts and Evidence—Extended

Level 4

Students display several concepts of survival illustrated by specific organisms with their physical characteristics and behavioral patterns.

Patterns of Relationships—Simple

Level 5

Students convey knowledge of relationships among concepts of survival supported by descriptions of multiple organisms and their habitats.

Example: A river is different from grassland because a river is body of water and grassland is land. A river is fast flowing. Grasshoppers live in grasslands. A grasshopper called a locust lays its egg in a thin case. One case could carry 100 eggs. The largest herbivores in the grassland are an elephant. In the African savanna meat-eats prey on grazing animals, such as zebra. Many animals live in grasslands. The river is a home to many animals. In just a drop of river water millions of animals can be living in it. Many fish live in the river. Many birds fly above the grasslands and rivers. A river is called freshwater because it has no salt in it.

Patterns of Relationships—Extended

Level 6

Students show complex relationships among concepts of survival emphasizing interdependence among organisms.

Example: River and grassland are alike and different. Rivers have lots of aquatic animals. Grasslands have mammals and birds. Rivers don't have many plants but grassland have trees and lots of grass. Rivers have lots of animal like fish trout and stickle backs. They also have insects and mammals, like the giant water bug and river otters. Grasslands usually have lions, zebras, giraffes, antelope, gazelles, and birds. In rivers the food chain starts with a snail. Insects and small animals eat the snail. Then fish eat the small animals and insects. Then bigger animals like the heron and bears eat the fish. Snails also eat algae with grows form the sun. In the grass lands the sun grown the grass. Animals like gazelle, antelope, and zebra eat the grass. Then animals like lions eat them. This is called a food chain of what eats what. In a way the animals are helping each other live. Animals have special things for uses. Otters have closable noses and ears. Gills let fish breath under water. Some fish lay thousands of egg because lot of animals like eating fish eggs. Some animals have camouflage. Swallow tail butter fly larva look like bird droppings. That is what I know and about grasslands rivers.

Appendix C

Questioning Rubric

Level 1: Factual Information

Questions are simple in form and request a simple answer, such as a single fact. Questions are a request for a factual proposition. They are based on naïve concepts about the world rather than disciplined understanding of the subject matter. Questions refer to relatively trivial, nondefining characteristics of organisms (plants and animals), ecological concepts, or biomes.

Examples for text about animals: How big are bats? Do sharks eat trash? How much do bears weigh?

Examples for text about biomes and organisms: Are there crabs in a river? How old do orangutans get? How big do rivers get? How big are grasslands? How many grasslands are there? How many rivers are there in the world? How many plants live in ponds?

Level 2: Simple Description

Questions are a request for a global statement about an ecological concept or an important aspect of survival. Questions may also request general information that denotes a link between the biome and organisms that live in it. The question may be simple, yet the answer may contain multiple facts and generalizations. The answer may be a moderately complex description or an explanation of an animal's behavior or physical characteristics. An answer may also be a set of distinctions necessary to account for all the forms of species.

Examples for text about animals: How do sharks have babies? How do birds fly? How do bats protect themselves? What kinds of sharks are in the ocean? What types of places can polar bears live? What kind of water do sharks live in? How many eggs does a shark lay? How fast can a bat fly? How far do polar bears swim in the ocean?

Examples for text about biomes and organisms: What bugs live in the desert? What kind of algae are in the ocean? How do desert animals live? How do grasslands get flowers and trees? How come it almost never rains in the desert? How long do sandstorms last? Why do rivers start at a hilltop?

Level 3: Complex Explanation

Questions are a request for an elaborated explanation about a specific aspect of an ecological concept with accompanying evidence. The question probes the ecological concept by using knowledge about survival or animal

biological characteristics. Questions may also request information that denote a link between the biome and organisms that live in it. Questions use defining features of biomes to probe for the influence those attributes have on life in the biome. The question is complex, and the expected answer requires elaborated propositions, general principles, and supporting evidence about ecological concepts.

Examples for text about animals: Why do sharks sink when they stop swimming? Why do sharks eat things that bleed? How do polar bears keep warm in their den? Why do sharks have three rows of teeth? Why is the polar bear's summer coat a different color? Why do all bats have sharp teeth? What kinds of sharks lay eggs? What kinds of bats hide in caves? Do fruit-eating bats have really good eyes? Do owls that live in the desert hunt at night?

Examples for text about biomes and organisms: What kinds of animals that eat meat live in the forest? Why do elf owls make their homes in cactuses? What makes the river fast and flowing? How do animals in the desert survive long periods without water? If the desert is hot, how can animals get so active?

Level 4: Pattern of Relationships

Questions display science knowledge coherently expressed to probe the interrelationship of concepts, the interaction with the biome, or interdependencies of organisms. Questions are a request for principled understanding with evidence for complex interactions among multiple concepts and possibly across biomes. Knowledge is used to form a focused inquiry into a specific aspect of a biological concept and an organism's interaction with its biome. Answers may consist of a complex network of two or more concepts.

Examples for text about animals: Do snakes use their fangs to kill their enemies as well as poison their prey? Do polar bears hunt seals to eat or to feed their babies?

Examples for text about biomes and organisms: Why do salmon go to the sea to mate but lay eggs in the river? How do animals and plants in the desert help each other? How does the grassland help the animals in the river? How are grassland animals and river animals the same and different? Is the polar bear at the top of the food chain?

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