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Effects of Integrated Instruction on Motivation and Strategy Use in Reading

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Effects of instructional context on intrinsic and extrinsic motivation have been examined with a variety of studies. This quasi experiment compared students receiving an instructional intervention designed to increase intrinsic motivation with students receiving traditional instruction. Concept-oriented reading instruction (CORI) integrated reading and language arts with science inquiry. It emphasized learning goals, real-world interaction (hands-on science activities), competence support (strategy instruction), autonomy support (self-directed learning), and collaboration. Traditional classrooms had the same content objectives and comparable teachers but different pedagogy. Children in CORI classrooms scored higher on motivation than did children in traditional classrooms, with effect sizes of 1.94 for curiosity and 1.71 for strategy use. Grade-level differences were found for recognition and competition. The results show that classroom contexts can be constructed to influence motivational outcomes positively.

In the present study, we focused on ways that intrinsic reading motivation can be enhanced through the implementation of a reading instructional program. Researchers have distinguished between intrinsic motivation, which refers to being motivated to do an activity for its own sake and out of interest and curiosity, and extrinsic motivation, or doing an activity to receive a reward or other form of recognition (Deci & Ryan, 1985; Deci, Vallerand, Pelletier, & Ryan, 1991). Intrinsic and extrinsic motivation are moderately and positively correlated (S. D. Miller & Meece, 1997), and both predict children's reading amount and frequency (Wigfield & Guthrie, 1997). However, in elementary students (Gottfried, 1990) and middle school students (Guthrie, Wigfield, Metsala, & Cox, 1999), intrinsic motivation is a stronger predictor of reading than extrinsic motivation. Unfortunately, children's intrinsic motivation often declines during the elementary school years (Harter, 1981; Wigfield et al., 1997).

Various classroom practices positively influence children's intrinsic motivation (for reviews, see Brophy, 1998; Guthrie & Alao, 1997; Stipek, 1996). Hence, we designed an instructional program that included multiple ways to influence children's intrinsic motivation positively, including providing autonomy support (through self-directed learning), competence support (via strategy instruction), relatedness support (from collaborative activities), learning goals (in the form of conceptual themes), and real-world interaction (in the form of hands-on science activities). The theoretical justification for these practices comes in part from self-determination theory, which emphasizes development of intrinsic motivation by support for individuals' autonomy, competence, and relatedness (Deci et al., 1991). Another theory underlying this study is goal theory, which concerns the purposes students have for learning (Ames, 1992; Maehr & Midgley, 1996; Thorkildsen & Nicholls, 1998).

There are both correlational and experimental supports for the practices included in the instructional program studied here. Deci, Schwartz, Sheinman, and Ryan (1981) and Grolnick and Ryan (1987) reported that students who perceived the classroom as autonomy supportive were more likely to be intrinsically motivated for learning than students who did not perceive autonomy support in the classroom. In experimental studies, the effects of choice in a learning task (e.g., autonomy support) on intrinsic motivation have been provided by Cordova and Lepper (1996) and McLoyd (1979).

Competence support has been examined in different ways. Skinner, Wellborn, and Connell (1990) reported that students were intrinsically motivated when they perceived the teacher to provide clear goals and contingencies for learning. These contingencies can be viewed as competence support because they permit students to perceive that they are gaining knowledge, learning skills, and becoming competent. Strategy instruction in reading has been found to be correlated with intrinsic motivation for learning (Pressley, Schuder, Bergman, & El-Dinary, 1992). Effective strategy instruction increases not only students' competence but also their awareness of competence, which is motivating (Pressley, Borkowski, & O'Sullivan, 1985).

Regarding relatedness support in the classroom, Skinner and Belmont (1993) documented that teachers' involvement (operationalized as teachers' knowledge about students), caring for students' welfare, and attention to students' learning process was

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associated with students' cognitive engagement (e.g., self-perceived competence, effort, and persistence in school work). In another study, students reported higher intrinsic motivation for learning if they perceived that the teacher cared about their progress and their well-being (Wentzel, 1997). Relatedness has also been studied as collaborative activity. Students working closely in a small group are likely to be fulfilling relatedness needs; such collaboration has been correlated with intrinsic motivation among primary students (Turner, 1995) and elementary students (Ng, Guthrie, Van Meter, McCann, & Alao, 1996).

Classroom practices fostering a learning goal orientation emphasize mastery of material (Ames, 1992; Brophy, 1998; Stipek, 1996). Students with learning goals seek to understand content, master skills, and gain competence. In contrast, students with performance goals attempt to maximize their grades, test scores, or public recognition for achievement (Ames, 1992). Teachers' focus on learning goals has a positive impact on students' intrinsic motivation and other aspects of motivation (Maehr & Fyans, 1989; Roeser, Midgley, & Urdan, 1996). Learning goals have been manipulated in a few experimental investigations. Graham and Golan (1991) found that students assigned to a performance goal condition decreased in their task-relevant effort and motivation, although those assigned to learning goal conditions did not show an increase in intrinsic motivation.

Real-world interaction refers to student observation of tangible objects, manipulation of materials, or conversation with persons from the community. Research support for effects of real-world interaction is limited. However, Ross (1988) found in a meta-analysis that science activities such as data collecting, observing, and recording aroused relatively high levels of attention, questioning, and active learning (see also Linn & Muilenburg, 1996). Sweet, Guthrie, and Ng (1998) found that teachers believed that experiences of real-world interactions were correlated with motivation (see also Nolen & Nichols, 1994). Real-world interaction has not frequently been subject to experimental manipulation. In one study, however, Anderson (1998) provided an interactive condition of observing and manipulating live turtles and crabs for some students and a no-interactive condition for other students. The interactive treatment condition significantly increased students' interest and interacted with a rich text condition to increase conceptual learning.

Evidence regarding classroom characteristics that influence reading motivation also comes from intervention studies. Au and Asam (1996) reported that students who participated in a program designed to enhance students' ownership over literacy activities appeared to increase their interest in reading and their sense of reading efficacy. In Guthrie et al.'s (1996) study, students who participated in concept-oriented reading instruction (CORI), the intervention studied here, increased in intrinsic motivation during a year of instruction. Morrow (1996) reported an intervention study in which students were provided autonomy support, competence support, collaboration, and learning goals. Students in the intervention condition were higher than students in a nonintervention comparison group on frequency of reading text. However, these intervention studies did not confirm that, compared with control groups, classroom instruction increased intrinsic motivation.

The present study was a quasi experiment designed to assess whether classroom intervention can influence students' intrinsic reading motivation. The intervention group participated in CORI, which includes five variables: autonomy support, competence support, collaboration, learning goals, and real-world interaction. As discussed earlier, CORI has increased children's reading performance and intrinsic motivation to read (Guthrie et al., 1996). In the present study, we build on this work by including a comparison group of children who received traditional reading instruction.

The instruction in the CORI program centered on interdisciplinary, conceptual themes. In the fall, the life science theme was *environmental adaptation*, and in the spring, the earth science theme was *weather*. Direct instruction was provided to teach the following reading skills: paragraph comprehension, information searching techniques, vocabulary, spelling, and expository text composition. The instruction provided a basis for self-perceived competence in reading. Within the classroom, emphasis was placed on autonomy support, consisting of empowering students to choose specific subtopics, texts, and modes of expressing their understanding in culminating projects. Real-world interaction was optimized by providing hands-on science activities, with student questions as guides for extended learning. Collaborative work to enhance relatedness among students was scheduled daily. Interesting texts for learning consisted of single-authored books on informational and literary topics. Teachers also emphasized learning goals; for instance, evaluation included teacher feedback on student work on the conceptual theme and class projects. Although grades were assigned systematically to some students' work, they were not emphasized as a goal of learning or a basis of social comparison. We emphasize that the purpose of this study was to look at the effects of these instructional practices as a package, rather than to attempt to isolate how each affects students' motivation.

The intervention was implemented at Grades 3 and 5. Grade level was included in the design because children's intrinsic motivation and sense of competence often decline during the elementary school years, generally, and in subjects such as reading (Harter, 1981; Wigfield et al., 1997), although strong age differences in reading motivation are not always obtained (Wigfield & Guthrie, 1997). We examined whether the older students had lower reading motivation than did the younger students. Our prediction was that in both conditions, fifth-grade students would have lower intrinsic motivation.

Students completed measures of intrinsic motivation, extrinsic motivation, and strategy use. Because CORI was designed to impact students' intrinsic motivation, we predicted that students in the CORI classrooms would have higher intrinsic reading motivation than students in traditional classrooms and that CORI students would report greater strategy use. We predicted that there would be no impact of CORI on students' extrinsic motivation.

In sum, this study was designed to test the following hypotheses: (a) Students receiving CORI should have higher intrinsic motivation (operationalized as *curiosity, involvement*, and *preference for challenge*) than students receiving traditional instruction; (b) CORI students should report greater cognitive strategy use than students receiving traditional instruction; (c) CORI students and students in traditional instruction should not differ in the extrinsic motivation aspects (e.g., *recognition* and *competition*); and (d) fifth graders should report lower reading motivation than third-grade students.

Method

Participants

Teachers and schools. Three schools bordering a large, mid-Atlantic state metropolis participated in this study. Each school had a multicultural population consisting of approximately 55% African American, 22% Caucasian, 15% Hispanic, and 7% Asian or "other" students. Two of the schools were designated as Chapter 1, and one school had a mainstream program for orthopedically disabled students. The schools were nominated by the district supervisor of reading as likely to benefit from an integrated curriculum for low-achieving students, and the principals were pleased to participate. All participating teachers volunteered for the study and were willing to teach in either CORI or traditional classrooms. The teachers at each grade in each school who were most similar in age, teaching experience, educational background, and management expertise were assigned to CORI and traditional classes. All teachers were between the ages of 41 and 50 years, had 20–24 years of teaching experience, and had bachelors' degrees as well as 45 hr of university credit.

CORI teachers participated in a summer workshop for 10 half days to plan instruction for the year. The CORI teachers, two reading specialists (one from each school), one university faculty member, and one university student collaboratively discussed instructional goals, student activities, teaching strategies, and resources (trade books and manipulatives) needed to implement the CORI principles into their classroom practices. Then, these teachers met 1 day per month during the school year to exchange progress, challenges, and pedagogical strategies.

Classrooms and students. Third-grade classrooms in all schools were self-contained, with the teacher providing all the instruction for approximately 30 students. In the fifth grade, teachers provided all the instruction for approximately 30 students, except for one period per day when students left the classroom for math with another teacher. Parental permission to participate in the study was obtained from all parents, including the CORI and comparison groups, and 100% of the students in each classroom participated. As a result of students moving away from the school, and the fact that HLM tolerates no missing data in between-class analyses, the sample size was reduced. A total of 41 fifth graders (18 girls, 23 boys) in two classrooms completed the year of CORI and the performance assessment. Forty-seven fifth-grade students (24 girls, 23 boys) from two different traditional classrooms within the same schools were the comparison students. Thirty-eight third graders (18 girls, 20 boys) in two classrooms completed the year of CORI and the performance assessment, and 36 third graders (16 girls, 20 boys) in two traditional classrooms were used for comparison. As a result of parents' moving, the attrition rate was 11% for Grade 5 and 17% for Grade 3. At each grade level, the proportion of boys and girls in CORI and traditional classrooms was not different, according to chi-square analyses. Students identified as learning disabled, orthopedically handicapped, and emotionally handicapped were included in the instruction and assessments. Low achievers from transitory home backgrounds were also included.

Design

This quasi experiment consisted of two instructional conditions, CORI and traditionally organized basal and science instruction. CORI was implemented in four classrooms, two at Grade 3 and two at Grade 5. Traditional classrooms within each school were selected for comparison with the CORI classrooms. These classrooms were selected on the basis of comparable students, teachers, and school settings. Outcome measures were curiosity, involvement, strategy use, recognition, and competition. *Past achievement* (California Test of Basic Skills score) was a covariate (e.g., a Level 1 predictor in hierarchical linear modeling; HLM). Though desirable for research, pretest measures of the motivation variables were not justifiable to the school administrators. For reasons described earlier, grade level was included in the analyses. We did not have a theoretical rationale for differential reaction of boys and girls to the instruction, and because of the reduced sample size, we did not include gender in the analyses. Ethnicity was not included in the analyses because the large diversity of different ethnic groups produced an insufficient sample size for comparisons.

We include here the timeline for the study: The past reading achievement was administered during the first 2 weeks of September 1995 for Grade 5 students and in May 1995 for Grade 3 students. The CORI intervention was implemented from September 1995 to June 1996 for both grades. An assessment was given during the first 2 weeks of April 1995, which included the measures of curiosity, involvement, preference for challenge, recognition, competition, and strategy use. Also, the conceptual knowledge assessment was given as part of a cognitive test of reading and science achievement. That test has been reported fully elsewhere (Guthrie, Anderson, Alao, & Rinehart, 1999).

Instructional goals. Both the CORI and traditional programs were directed toward identical goals for English/language arts and science. Teachers in both traditional and CORI classrooms worked toward the same instructional goals of text comprehension, reading and writing in multiple genres, and integrating information. In English/language arts, the objectives consisted of interpreting stories, comprehending expository texts, locating and integrating information from multiple texts, summarizing, self-monitoring, writing personal narratives, composing informational reports, and writing poetry. In science, the common goals included understanding the life cycles of plants and animals, describing important adaptations of animal species, understanding the cycles of weather and seasons, collecting data, interpreting graphs and tables, and interpreting data from class-wide projects. More complex, higher order goals were adopted for fifth graders than for third graders. Although the objectives were constant across the classrooms, as discussed more thoroughly in the next section, the methods differed in the CORI and traditional classrooms. Further, instruction was adjusted to meet the needs of all learners, including approximately 5 students in each Grade 3 CORI classroom who entered the year reading at a 1.5 grade level. These adjustments consisted of providing developmentally appropriate texts and evaluating achievement individually in terms of each student's progress.

CORI. The teaching framework for CORI includes four phases: (a) observe and personalize, (b) search and retrieve, (c) comprehend and integrate, and (d) communicate to others. To implement this framework, teachers first identified a conceptual theme for instructional units to be taught for 16–18 weeks in the fall and spring. The themes selected by third-grade teachers were the adaptations and habitats of birds and insects for the fall. In the spring, the third-grade units were weather, seasons, and climate. Fifth-grade units in the fall were life cycles of plants and animals, and the spring units emphasized earth science, including the solar system and geological cycles. At both grade levels, teachers used trade books rather than basal text series.

At the beginning of each unit, students performed observational and hands-on activities both outside and inside the classroom. Third and fifth graders participated in activities such as collecting and observing crickets, constructing spider webs, dissecting owl pellets, and building weather stations. Within each activity, students personalized their learning by composing their own questions as the basis for observing, reading, and writing. Student questions included a structural focus such as "How many types of feathers does a bird have?" Challenging, conceptual questions such as "Why does that bird have such a long beak?" evolved as students attempted to explain the phenomena they had observed. These questions generated opportunities for autonomy support and self-directed learning. Students chose their own subtopics and books. Students constructed their personal goals for communicating to others. Relatedness was supported by allowing students to collaborate with self-selected peers in retrieving information and communicating their knowledge to others.

The second phase of the CORI framework consists of searching and retrieving information related to the students' questions. Students were taught how to use the library, find books, locate information within expository texts, and use diverse community resources. In addition, direct strategy instruction was provided to help students integrate across information sources, including texts, illustrations, references, and human experts. Informational texts, folklore, novels, and poetry were woven through the instruction. Most of the teachers began the units with a narrative related to the theme that students read during science observations. Following observing and forming conceptual questions, teachers moved to informational texts. As students concluded their in-depth study of multiple informational texts, teachers introduced novels, chapter books, and poetry related to the conceptual theme of the unit.

The last phase of the CORI framework involves communicating to others. Having gained expertise in a particular topic, students were motivated to speak, write, discuss, and display their understanding to other students and adults. In both third- and fifth-grade classrooms, students made posters, wrote classroom books, and composed extended displays of their knowledge. One class made a videotape of its weather unit, providing a lesson on weather prediction and an explanation for the rest of the school.

Traditionally organized instruction. The teachers in the traditional classrooms followed their usual pattern of using the teacher's guide and the sequence of content and activities in the McGraw-Hill basal program for both Grade 3 and Grade 5. Students answered the end of the unit questions and were provided materials that matched their reading levels. Science content in the third- and fifth-grade basal-reading classrooms was directed to similar objectives as the CORI classrooms. Topics of adaptation, life cycles, weather and seasons, and solar systems were the goals of instruction. However, traditional classrooms did not emphasize learning goals or conceptual mastery. Rather, they emphasized coverage of Addison Wesley textbooks and McGraw-Hill basals. Traditional classrooms had no hands-on science inquiry. Collaborative work on integrated reading-inquiry science projects was not present. Therefore, traditional classrooms were low on the following variables: learning goals, real-world interaction, competence support (cognitive strategy instruction), autonomy support, and collaboration. They emphasized performance goals in the form of test scores, textbook coverage, individual work, and teacher-directed learning.

The traditional teachers were frequent visitors to the CORI classrooms, adopting a few of the texts used in the CORI classrooms. This sharing may have led to an underestimate of the distinctiveness of the CORI program and to a conservative quasi-experimental comparison. It is possible that the teachers and students in the comparison classrooms felt they were neglected by not being in the experimental group, and that they decreased their effort toward academic goals. Although we do not have data on this point, our strong impression was that the comparison teachers in fact increased their effort as a result of the study. The school is in a high-accountability district and state. All teachers were dedicated to high achievement. If anything, the comparison teachers tried harder because of the study, termed the "John Henry effect" by some methodologists (Pedhazur & Schmelkin, 1991).

Measures

Student motivation. Students' motivation was measured using the Motivation for Reading Questionnaire (MRQ), a questionnaire designed to measure different aspects of reading motivation. This questionnaire has been used in two previous studies of the nature of reading motivation. Wigfield and Guthrie (1997) reported factor analyses of the MRQ, showing that 11 factors were theoretically and statistically justifiable. Baker and Wigfield (1999) did further confirmatory factor analytic work on the different aspects of reading motivation, providing additional evidence for the multidimensional nature of reading motivation. For the present study, three of the MRQ subscales were chosen as indicators of intrinsic motivation: curiosity, involvement, and preference for challenge.

In the present study, we further assessed the factor structure of intrinsic and extrinsic aspects of motivation measured on the MRQ. We conducted a factor analysis with varimax rotation using all 18 items from the intrinsic motivation scales of curiosity, involvement, and preference for challenge. In this factor analysis, the items representing preference for challenge merged into the other factors. Therefore, we conducted a factor analysis with varimax rotation using the 11 items from the curiosity and involvement scales. This resulted in two factors, both with eigenvalues over 1 and accounting for 32% and 10% of the variance, respectively. In the first factor, involvement, Items 16, 19, 21, 22, 24, and 28 were included (see Appendix). Five of these items were identical to those used previously and, therefore, to maintain consistency with earlier reports, these five were used for the measure of involvement in this study. In the second factor, curiosity, Items 3, 5, 9, 7, and 27 were included. Four of these items were the same as the previously established scale and, thus, were used as the measure of curiosity in this study.

We measured two aspects of extrinsic motivation identified in the Wigfield and Guthrie (1997) and Baker and Wigfield (1999) studies: recognition and competition. We conducted a factor analysis with varimax rotation using the 11 items that comprised the recognition and competition scales. We found two factors with eigenvalues higher than 1, accounting for 34% and 12% of the variance, respectively. The five items comprising the first factor, recognition, were present in the previously established scale and, thus, were used as the measure of recognition. Four items comprising the second factor, competition, were present in the previously established scale; these items were used as the competition measure for this study. These measures were administered as posttests but not as pretests because parallel forms did not exist and the school administrators did not favor pretesting. This reduces the certainty that CORI influenced these variables. The scales are described more specifically next.

Curiosity refers to the students' disposition to learn about the world around them and gain conceptual knowledge through reading. The curiosity subscale had four items (see Appendix) that were identical to the items measuring curiosity in Wigfield and Guthrie (1997). The response format was 1 = *very different from me*, 2 = *a little different from me*, 3 = *a little like me*, and 4 = *a lot like me*. Internal consistency reliability, as measured by Cronbach's alpha, was .52.

Involvement refers to the students' desire to become absorbed in text. This often emphasizes the fiction genre but may also include information books. The involvement subscale had five items that were the same as the items in Wigfield and Guthrie (1997). The response format was the same as that for curiosity. Internal consistency reliability was .70.

Recognition refers to the desire for public acknowledgment and positive evaluation of performance in reading. The recognition subscale consisted of five items identified in the factor analysis and used in Wigfield and Guthrie (1997). The response format was the same as that for curiosity. Internal consistency reliability was .69.

Competition refers to the desire to be superior to classmates and peers in reading tasks, activities, and standards. The competition subscale consisted of four items identified in the factor analysis that were also used in Wigfield and Guthrie (1997). The response format was the same as that for curiosity. Internal consistency reliability was .67.

Strategy use. Strategy use refers to a student's report of using a range of cognitive strategies to comprehend texts and to learn in the classroom. This subscale (see Appendix) was written by Alao to address strategy use in reading and learning in science (Alao & Guthrie, 1999). Because CORI was implemented in science content, the questions were relevant to learning and reading in science. The measure is similar to measures of cognitive engagement in science (Meece, Blumenfeld, & Hoyle, 1988) and self-regulation in English (Pintrich & DeGroot, 1990), and is closely related to a performance assessment used to assess strategy use in integrated reading and science instruction (Guthrie et al., 1998). The questions were relevant both to CORI and traditional students. Response format was the same as the one for the motivation subscales. Internal consistency reliability was .70.

Past achievement. Standardized reading achievement was used as a variable to control students' previous reading level. Vocabulary and comprehension scores from the California Test of Basic Skills were drawn from the cumulative records of Grade 3 students. The Metropolitan Achievement Test comprehension section was administered by teachers to the Grade 5 students. Both measures were administered in the fall of 1995, and the comprehension test was a statistical control for individual differences.

Instructional Questionnaire and Intervention Check

All the teachers replied to a 75-item instructional questionnaire designed to represent the similarities and differences of CORI and traditional basal-oriented instruction (see Guthrie et al., 1996). The scales were intended to represent the CORI principles, as described in the Introduction, including conceptual theme (challenge), real-world observation (personal significance), self-direction (autonomy development), strategy instruction (self-perceived competence), collaboration (relatedness), self-expression (evaluation of individual progress), and coherence among all the principles. Each of these seven scales was bipolar. For example, the scale on coherence addressed integration of language arts and science from more integrated (e.g., CORI-like) to less integrated (e.g., traditional). Items were set on a 4-point Likert scale. The response choices were 1 = *very true of my class*, 2 = *somewhat true of my class*, 3 = *not very true of my class*, and 4 = *not at all true of my class*. Reliabilities of the scales were .89 (conceptual theme), .90 (real-world observation), .91 (self-direction), .75 (strategy instruction), .66 (collaboration), .47 (self-expression), and .71 (coherence). All the CORI teachers were equal to or higher than the median for the whole group on each scale. The traditional teachers were equal to or lower than the CORI group on each scale. No CORI teacher was equal to the median on more than two scales, and no traditional teacher was equal to the median on more than two scales; that is, CORI teachers provided instruction with these characteristics more fully than the traditional teachers.

To follow up the questionnaires qualitatively, videotape-based interviews were conducted. Three lessons of each teacher were taped during the fall of 1995. Each lesson was selected by the teacher to show her best instruction. Teachers were interviewed as they watched the tape. Although all teachers were interviewed on all principles, each CORI teacher was randomly assigned two principles of instruction (e.g., real-world observation and self-direction). The interview was extended on these principles to probe more deeply. The teachers' extent of utilization and implementation of a principle (e.g., support for self-directed learning), as revealed in the interviews, corroborated their questionnaire report. For example, there was no case in which a teacher reported a low level of emphasis on a certain principle in the interview and a high level on the questionnaire. Their replies confirmed their responses to the questionnaires and verified the soundness of the construct validity of the scales. Although the implementation of CORI varied across the teachers, these principles were consistently more apparent in CORI classrooms than in the traditional teachers' classrooms.

Analytical Model

We used HLM to examine the hypotheses (Bryk, Raudenbush, & Congdon, 1996). This analysis enabled us to examine the effect of instructional differences between classrooms on motivational outcomes. Compared with analysis of variance (ANOVA) procedures, a unique feature of HLM is that it accommodates the clustered nature of data in quasi-experimental designs such as the one used in the present study. When treatments are applied to classrooms, scores of individuals may show intraclass correlation (ICC), which refers to within-classroom clustering. HLM permits partitioning of total variance to within-class and between-class sets. The analysis also enabled us to control the outcome variables for the effects of previous achievement of individual students. Thus, we first examined the degree of ICC and found it to be non-zero in fully unconditional models of all the variables. This ICC can be used to determine whether individuals within classrooms are more similar on outcomes than individuals between classes. When the ICC is substantial, HLM is warranted because an ANOVA underestimates the standard errors. Next, we conducted within-class analyses to determine the effects of previous achievement on motivational and strategy use outcomes; the effects were generally negligible. Finally, we examined effects attributable to type of instruction and grade level on between-class differences in motivational and strategy use outcomes.

Results

Correlations of the variables are presented in Table 1, and the means and standard deviations are shown in Table 2. Results of the unconditional HLM are shown in Table 3.

Unconditional HLM

The first step in analysis of each of our five models was to use a fully unconditional two-level HLM to partition the variance in motivational and strategy use outcomes into between-class and within-class components. This model is "unconditional" because the variance components are not predicted by any variables. The results can be interpreted essentially the same way as a one-way ANOVA with random effects. Variance estimates produced by the unconditional HLM are used to calculate ICC, an index that measures the degree to which members of the same class respond in a more similar manner than do members of different classes. The adjusted ICCs for between-class variability were 21% for curiosity, 10% for involvement, 15% for strategy use, 9% for recognition, and 11% for competition. These ICCs are proportions of total variance represented by between-class sources. (The term *correlation* should not be confused with the Pearson correlation

Table 1
Correlations Among Motivation Outcomes and Previous Achievement for Grades 3 and 5

Motivation outcomes	1	2	3	4	5	6
1. Curiosity	—	.46**	.67**	.36**	.32**	−.02
2. Involvement	.38**	—	.33**	.51**	.40**	−.02
3. Strategy use	.61**	.30**	—	.34**	.39**	−.05
4. Recognition	.30**	.45**	.28**	—	.42**	−.15
5. Competition	.20	.30**	.09	.33**	—	.00
6. Past achievement	−.01	.10	.14	.10	−.17	—

Note. Correlations for Grade 3 are above the diagonal; those for Grade 5 are below the diagonal.
** $p < .01$.

Table 2
Means and Standard Deviations for Motivation Outcomes for Concept-Oriented Reading Instruction (CORI) and Traditional Instruction at Grades 3 and 5

Motivaiton outcomes	CORI			Traditional		
	Grade 3	Grade 5	Total	Grade 3	Grade 5	Total
Curiosity						
M	12.81	12.96	12.89	10.52	10.65	10.59
SD	2.46	1.84	2.12	2.68	2.65	2.64
Involvement						
M	17.03	14.96	15.85	14.42	14.83	14.63
SD	2.82	3.17	3.18	4.17	3.59	3.86
Strategy use						
M	19.22	19.22	19.22	16.76	17.68	17.24
SD	3.47	3.00	3.19	3.87	3.55	3.71
Recognition						
M	17.92	15.82	16.73	16.50	15.83	16.15
SD	2.14	2.61	2.62	3.50	3.23	3.36
Competition						
M	13.53	11.74	12.52	12.21	11.22	11.70
SD	2.79	2.76	2.90	2.90	3.36	3.17

coefficient.) These nonzero ICCs provide justification for using hierarchical models to answer our research questions. Ignoring these ICCs and analyzing disaggregated data in a nested design such as this underestimates standard errors and inflates the Type I error.

Unconditional Within-Class HLM

The unconditional within-class model estimates an individual's motivational outcomes as a function of the mean outcome of students in his or her class (γ_{00}) and prior achievement (γ_{10}). Because it was grand-mean centered, the mean can be interpreted as the outcome of a student whose prior achievement is equal to the grand mean of all students. Class mean achievement is modeled as a random parameter, but prior achievement is fixed because there was no significant variance in the effects of prior achievement on motivational outcomes. Within-class effect sizes were computed by dividing each HLM gamma by the pooled within-group standard deviation in the fully unconditional model (shown in Table 3). Prior achievement had no influence on motivational outcomes. Students of all abilities are equally likely to be curious, to be involved, to seek recognition, to be competitive, and to use strategies. The estimates of random effects for each of the five Level 1 models suggest that there were significant amounts of variance between classes on each motivational outcome that might be explained by type of instruction and grade level (see Table 4). Although the effect was marginal for recognition ($p < .10$), which was not expected to be influenced by CORI, we analyzed it to examine a possible instructional or grade effect.

Conditional Between-Class Model

The first hypothesis was that CORI students would show higher curiosity and involvement than traditional students. As shown in Table 5, CORI appears to have a strong, positive association with student curiosity ($p < .001$), regardless of grade level. The effect size for curiosity was 1.94. Because type of instruction was grand-mean centered, effect sizes can be interpreted as the deviation of the mean of CORI classes from the mean achievement of traditional classes. Because instructional conditions were binary (e.g., either CORI or traditional), it is reasonable to state that students in CORI classrooms were typically 1.94 *SD*s higher in curiosity than students in traditional classrooms. This result confirms the first hypothesis. However, CORI and traditional students were not different in involvement, which does not confirm the first hypothesis.

As can be seen in Table 5, CORI students were significantly higher than traditional students in strategy use ($p < .05$). This

Table 3
Fully Unconditional HLM for Partitioning Variance in Class Achievement

Source of variance	Curiosity	Involvement	Strategy use	Recognition	Competition
Between-class variability (τ)	1.30	0.70	1.28	0.47	0.60
Within-class variability (σ^2)	5.86	12.15	11.80	8.64	8.80
Reliability of intercept β_0, (λ)	0.81	0.53	0.68	0.52	0.58
Intraclass correlation[a]	0.18	0.05	0.10	0.05	0.06
Adjusted intraclass correlation[b]	0.21	0.10	0.15	0.09	0.11

[a] The intraclass correlation is calculated with the formula $\tau/(\tau + \sigma^2)$. [b] The adjusted intraclass correlation is calculated with the formula $\tau/(\tau + \sigma^2 \cdot \lambda)$.

Table 4
Unconditional Within-Class Hierarchical Linear Modeling for Estimating the Effects of Prior Achievement on Motivation

Motivational outcome	Class *M* (β_0)	Prior achievement (β_1)	τ_{00}[a]	σ^2
Curiosity			1.45***	5.84
Coefficient	11.74	.00		
Effect size		.00		
Involvement			0.80*	12.16
Coefficient	15.28	.00		
Effect size		.00		
Strategy use			1.54**	11.75
Coefficient	18.22	.01		
Effect size		.00		
Recognition			0.44†	8.57
Coefficient	16.48	.00		
Effect size				
Competition			0.54*	8.56
Coefficient	12.18	.01		
Effect size		.00		

Note. Effect sizes were calculated by dividing each beta coefficient by the pooled within-school standard deviation, which was calculated by taking the square root of σ^2 from Table 3.
[a] The variance of class intercepts when prior achievement is controlled.
† $p < .10$ (marginally significant). * $p < .05$. ** $p < .01$. *** $p < .001$.

result confirms the second hypothesis. The effect size was 1.71, indicating that CORI students were typically 1.71 *SD*s higher than traditional students in strategy use.

The third hypothesis, that CORI students would not differ from traditional students in recognition or competition, was confirmed. Although the effect sizes were moderate, the between-class variance was not significantly associated with instructional approach.

The fourth hypothesis was that fifth graders would report lower motivation than third graders. Consequently, the effect sizes represent the expected change in the outcome variable for two different grades. For recognition, fifth graders were significantly lower than third graders ($p < .05$), with a relatively moderate effect size of −1.05. Because grade was grand-mean centered, fifth graders scored 1.05 *SD*s lower than the average of all students, and third graders scored 1.05 *SD*s higher than the average of all students. In

Table 5
Conditional Model of Effects of Type of Instruction and Grade Level on Five Motivational Outcomes

Motivational outcome	Class *M* (γ_{00})	Instruction (γ_{01})	Grade (γ_{02})	Prior achievement (γ_{10})	τ_{00}[a]	σ^2	R^2[b]	λ	Model performance[c]
Curiosity					.001	5.75	.99	.81	.80
Coefficient	11.73	2.35**	0.07	.004					
Effect size		1.94	0.06						
Involvement					.39	12.15	.51	.53	.27
Coefficient	15.28	1.35	−0.43	.004					
Effect size		1.52	0.47						
Strategy use					.45	11.75	.71	.68	.48
Coefficient	18.21	2.12*	0.22	.006					
Effect size		1.71	0.18						
Recognition					.01	8.60	.98	.52	.51
Coefficient	16.50	0.59	−0.69*	.003					
Effect size		0.89	−1.05						
Competition					.07	8.60	.87	.58	.50
Coefficient	12.20	0.73	−0.65*	.002					
Effect size		1.00	−0.89						

Note. Effect sizes were calculated by dividing each beta coefficient by the pooled within-school standard deviation, which was calculated by taking the square root of σ^2 from Table 4.
[a] τ_{00} is the variance of class means when type of instruction and grade have been controlled.
[b] R^2 was calculated by determining the proportion of variance that is explained by Level 2 predictors; the following formula was used: (τ unconditional within-class model − τ conditional between-class model)/τ unconditional within-class model.
[c] Model performance was calculated by multiplying R^2 by parameter reliability, λ.
* $p < .05$. ** $p < .01$.

competition, fifth graders were also significantly lower than third graders ($p < .05$), with an effect size of $-.89$. In curiosity and involvement, however, there was no significant difference between the grades. Thus, this hypothesis was not fully supported.

The total variance explained by the model is the product of reliability (λ) times the proportion of parameter variance explained by the model. The researcher calculates the proportion of parameter variance explained by comparing the amount of variance around each parameter in the unconditional model (τ_{00} in Table 5) with the remaining unexplained variance around each parameter in the conditional model (τ_{00} in Table 4). See Table 5 for the procedures for computing model performance. In our models, between 51% (involvement) and 99% (curiosity) of the variance in average motivation of students in the same class could be explained by type of instruction and grade level. Prior achievement accounted for no significant variability in student achievement. When adjusted for reliability, the model containing type of instruction and grade explained between 27% (involvement) and 80% (curiosity) of the variance in motivational outcomes.

Discussion

The study combined five classroom practices into a classroom intervention that was designed to increase children's intrinsic reading motivation. The five practices have been documented in prior research as important for children's motivation (Brophy, 1998; Guthrie & Alao, 1997; Stipek, 1996). Consistent with self-determination theory that emphasizes support for autonomy, competence, and relatedness, the intervention included instructional characteristics designed to emphasize (a) autonomy support, (b) competence support, (c) collaboration, (d) learning goals, and (e) real-world interaction (Deci & Ryan, 1985; Skinner et al., 1990). The findings of this investigation are represented in four parts. First, the students who received CORI had significantly higher curiosity for reading at the end of the academic year than comparison students who received traditional reading and science instruction. The second finding is that students receiving CORI were higher than students receiving traditional instruction in self-reported strategy use. This effect of CORI on strategy use was expected and is similar to the instructional effects on cognitive engagement (Meece, 1991). The third finding is that students receiving CORI were not significantly different from comparison students on recognition or competition. This lack of effect was consistent with the intentions of the instructional design, which were to enhance intrinsic motivations for reading but not to address extrinsic motivation either positively or negatively.

The fourth finding is that there were grade effects on recognition and competition but not on curiosity, involvement, or strategy use. On the basis of previous research (Harter, 1981; Wigfield et al., 1997), we predicted fifth-grade students to be lower in intrinsic motivation than the third-grade students. However, given that researchers using the MRQ found few age differences in different aspects of reading motivation (Baker & Wigfield, 1999; Wigfield & Guthrie, 1997), the findings in this study are not completely unexpected. The discrepant findings across studies are likely due to measurement differences or sample differences in the various studies. More research is needed to examine the strengths of age differences in reading motivation.

The observed intervention effects on students' motivation and strategy use are consistent with correlational and experimental literature on the various individual instructional practices. Regarding autonomy support, they confirm results of the study by Deci et al. (1981), in which students who perceived the classroom as autonomy supportive were more likely to be intrinsically motivated for reading than students who did not perceive autonomy support in the classroom. Similar findings by Skinner and Belmont (1993), who observed reciprocal relations of autonomy support and motivation, were confirmed. Experimental studies in laboratory settings, showing the effects of learner choice in instructional tasks (Cordova & Lepper, 1996; McLoyd, 1979) on intrinsic motivation and interest, were supported. In the present investigation, the variable of autonomy support, however, was operationalized within a classroom context in long-term instruction.

Competence support in the classroom has been examined by Skinner et al. (1990) in terms of clear goals and contingencies for learning. In the present study, competence support was operationalized as direct strategy instruction within an integrated curriculum. This strategy instruction may be viewed as competence support, which increases intrinsic motivation as well as cognitive strategy use.

The CORI intervention focused on enhancing students' learning or mastery goals. Thus, our results support correlational findings that a mastery orientation is associated with students' intrinsic motivation (Maehr & Fyans, 1989; Maehr & Midgley, 1996; R. B. Miller, Behrens, Greene, & Newman, 1993). In addition, the present findings confirm experimental studies that show how learning goals (Graham & Golan, 1991) and a task-mastery orientation (Benware & Deci, 1984) foster intrinsic motivation.

Effects of real-world interactions in increasing intrinsic motivation have been reported by teachers as important (Hootstein, 1995; Nolen & Nichols, 1994; Sweet et al., 1998; Zahorik, 1996). However, relatively few empirical studies have examined this variable. The present findings are consistent with the meta-analysis by Ross (1988), which found that student attention, questioning, and active learning are associated with data collection and real-world observation. They support the notion that practical real-world problems arouse attention, interest, and sustained effort in science problem solving (Linn & Muilenberg, 1996). The present findings confirm experimental interventions that merge real-world interaction with learning from science text (Romance & Vitale, 1992).

As noted earlier, in this study, we did not attempt to identify effects of any single variable in isolation. Rather, to increase intrinsic motivation, we attempted to connect variables such as autonomy support to other variables such as learning goals and real-world interactions. It is likely that all five variables have main effects and interaction effects on intrinsic motivation. The purpose of this investigation was not to identify their individual effects but to determine their combined contributions to motivation. In the future, researchers may wish to assess different combinations of these variables.

There are several limitations to this study. Although we measured motivation and strategy use outcomes, we did not give these measures as pretests. Previous achievement was used as a controlling variable, but pretests of the dependent variables would have made it possible to draw stronger causal inferences. The advantage of CORI could have been due to preexisting differences in motivation. However, parallel forms of the motivation measures do not exist, and test effects with the same form are possible. Therefore, pretesting poses a different kind of threat to causal inferences. Classroom groups were formed by the principal and teachers to be similar to each other in reading achievement and motivation, and preexisting differences in these variables were not evident to them. However, confirming evidence from experimental studies with random assignment or pretest–posttest designs is needed.

There are mutually supportive relationships between cognitive outcomes, such as reading achievement and conceptual knowledge observed in prior studies (Guthrie et al., 1998), and the motivation outcomes observed here. Larger samples and measures administered simultaneously would permit examination of how multiple processes of engagement in reading and science learning influence each other across time. We did not have large enough samples to examine treatment effects on boys and girls or on different ethnic groups. Finally, we used self-report measures of motivation and strategy use. Although this practice is common in the field, assessing these outcomes using multiple methods is an important next step in this area.

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Appendix

Constructs and Items for Students' Motivation, Strategy Use, and Social Goals

Curiosity

1	2	3	4
very different from me	*a little different from me*	*a little like me*	*a lot like me*

3. If the teacher discusses something interesting, I might read more about it.
5. I read about my hobbies to learn more about them.
9. I read to learn new information about topics that interest me.
22. If I am reading about an interesting topic, I sometimes lose track of time.
27. I enjoy reading books about people living in different countries.

Involvement

1	2	3	4
very different from me	*a little different from me*	*a little like me*	*a lot like me*

7. I read stories about fantasy and make believe.
16. I make pictures in my mind when I read.
19. I feel like I make friends with people in good books.
21. I like mysteries.
24. I enjoy a long involved story or mystery book.
28. I read a lot of adventure stories.

Challenge

1	2	3	4
very different from me	*a little different from me*	*a little like me*	*a lot like me*

1. I like hard, challenging books.
4. I like it when the questions in books make me think.
17. I usually learn difficult things by reading.
26. If the project is interesting, I can read difficult material.
29. If the book is interesting, I don't care how hard it is to read.

Recognition

1	2	3	4
very different from me	*a little different from me*	*a little like me*	*a lot like me*

10. My friends sometimes tell me I'm a good reader.
13. I like hearing the teacher say I read well.
18. I am happy when someone recognizes my reading.
20. My parents often tell me what a good job I'm doing in reading.
23. I like to get compliments for my reading.

Competition

1	2	3	4
very different from me	*a little different from me*	*a little like me*	*a lot like me*

8. I like being the only one who knows the answer in something we read.
14. I like being the best at reading.
15. It is important for me to see my name on a list of good readers.
25. I try to get more answers right than my friends.
30. I like to finish my reading before other students.
32. I am willing to work hard to read better than my friends.

Strategy Use

1	2	3	4
I strongly disagree	*I disagree*	*I sort of agree*	*I strongly agree*

1. I usually find a quiet place to do my science work.
2. When I do my science homework on the food chain, I usually use the dictionary, my science class notes, and my science book.
3. When I study for a science test, I try to see how my reading fits with what I had learned before in science.
4. In science class, I try to see how what we are learning fits with what I know.
5. I use questions like, why, what, and how to understand my science work on plants and animals.
6. I am always looking for ways to make science more fun for myself.

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