THE EFFECTIVENESS OF A TECHNOLOGICALLY FACILITATED CLASSROOM-BASED EARLY READING INTERVENTION

The Targeted Reading Intervention

ABSTRACT

The purpose of this study was to evaluate the efficacy of a classroom-teacher-delivered reading intervention for struggling readers called the Targeted Reading Intervention (TRI), designed particularly for kindergarten and first-grade teachers and their struggling students in rural, low-wealth communities. The TRI was delivered via an innovative Web-conferencing system using laptop computers and webcam technology. Seven schools from the southwestern United States were randomly assigned to experimental and control conditions in a cluster randomized design. All children in the study ($n = 364$) were administered a battery of standardized reading skill tests in the fall and spring of the school year. Intent-to-treat analyses were conducted to estimate mixed models of children's 1-year growth in Word Attack, Letter/Word Identification, Passage Comprehension, and Spelling of Sounds. Results showed that struggling readers from experimental schools outperformed those from control schools on all spring reading outcomes, controlling for fall scores.

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RESEARCHERS have documented that without intervention, young children who struggle with learning how to read in early elementary school tend to fall behind their peers in reading and other academic areas (Alexander & Entwisle, 1988; Foorman & Torgesen, 2001), and many are likely to remain behind their peers throughout their schooling. Researchers and practitioners com-

monly agree that early intervention is essential for those children who are struggling readers and who do not seem to benefit from traditional classroom instruction (e.g., Clay, 1993; Morris, Tyner, & Perney, 2000; Snow, Burns, & Griffin, 1998). Particular groups of children appear to be most at risk for early reading difficulties, including children with phonological problems as well as children who have less well-developed oral language who may also have phonological problems. This latter group often includes children who live in poverty and who may not have had preschool experiences that would have helped them benefit from regular classroom reading instruction (Foorman & Torgesen, 2001; Snow et al., 1998). At the same time, researchers have demonstrated relationships between struggling students' reading improvement and well-known early reading interventions such as Reading Recovery (Clay, 1993; Shanahan & Barr, 1995), Success for All (Slavin et al., 1996), and Early Steps (Morris et al., 2000), as well as four reading programs in a recent randomized clinical trial by the U.S. Department of Education (Torgesen et al., 2006, 2007).

Although struggling students may demonstrate reading improvement when provided one-to-one tutoring by reading specialists, paraeducators, or volunteers (e.g., Elbaum, Vaughn, Hughes, & Moody, 2000), this tutoring instruction often takes place outside of the regular education classroom. Such pull-out models can present problems for instructional continuity between the regular education classroom and the tutoring setting, and they may also limit the classroom teacher's opportunities to take on additional reading instructional exchanges with students who have the greatest reading instructional needs. Thus, recent reports and programs have emphasized the need for classroom teachers to provide some specialized support for struggling readers in the regular classroom. For instance, Reading First (U.S. Department of Education, 2002) implementation includes specialized programs such as Voyager Passport (Voyager Expanded Learning, 2009), which classroom teachers use with their struggling readers to help them gain proficiency in early reading. In addition, the response-to-intervention framework suggests a tiered approach to reading instruction and intervention for struggling readers. Recent research has shown that some of these struggling readers can indeed be served in the regular classroom setting, which may even prevent them from being identified for special education (Gersten et al., 2008). Given this new emphasis on classroom teachers in helping struggling readers, it is important to understand if classroom teachers can be effective in delivering specialized reading instruction to struggling readers, if this kind of intervention is effective for those struggling students, and if the intervention does not detract from other students' learning.

The purpose of our study was to evaluate the efficacy of a classroom-teacher-delivered reading intervention for struggling readers in kindergarten and first grade called Targeted Reading Intervention (TRI). The intervention was designed particularly for rural kindergarten and first-grade teachers and their struggling students in rural, low-wealth communities with limited access to professional development or intervention services. TRI provided kindergarten and first-grade teachers with diagnostic strategies designed to facilitate rapid reading progress for struggling students, ongoing professional development, and long-distance coaching via webcams. Classroom teachers delivered the intervention in one-on-one 15-minute teaching sessions facilitated by in-classroom literacy coaching via an innovative Web-conferencing system using laptop computers and webcams. Through this technology, a teacher working with a struggling reader could see and hear the literacy coach over one

thousand miles away, and the coach could see and hear the teacher working with individual children and give live feedback about the teacher's instructional strategies as well as the child's observed instructional needs. The TRI literacy coach was not physically present in the classroom, and teachers had differing needs with respect to their TRI learning. Therefore, TRI literacy coaches used multiple techniques when coaching teachers. At times, TRI coaches redirected a teacher's instruction during a lesson, such as requesting that a teacher use a different set of words or text, or talking through how to implement a certain strategy. At other times a teacher engaged the TRI coach in a discussion of his or her current instructional focus or practice. Finally, particularly later in the school year, the TRI coach observed almost an entire lesson and debriefed with the teacher upon lesson conclusion.

Design, Research Questions, and Hypotheses

This study was a cluster-randomized design in which schools were randomly assigned to experimental and control conditions. Children were administered a battery of standardized reading tests in the fall and spring of the school year. Teachers filled out questionnaires about their professional backgrounds and classrooms in the fall and spring. Analyses estimated mixed models of children's 1-year growth in Word Attack, Letter/Word Identification, Passage Comprehension, and Spelling of Sounds.

There were three research questions that guided the study: (1) Did struggling kindergarten and first-grade students who received TRI from their classroom teachers, supported by a TRI literacy coach via webcam technology, perform at a higher level on spring reading outcome scores than struggling students in control schools when fall entry scores were controlled for? (2) Did students (both struggling and nonstruggling) from classrooms with TRI-trained teachers perform at a higher level on spring reading outcome scores than students from classrooms with control teachers when fall entry scores were controlled for? (3) Did students' fall vocabulary scores impact the effectiveness of the TRI on students' spring reading outcomes?

We had several expectations in undertaking this study. First, we hypothesized that struggling students from schools implementing TRI would have higher scores than struggling students from control schools on all reading outcome measures. Second, we hypothesized that both struggling and nonstruggling students from TRI schools would have higher reading outcomes in the spring of the year compared to struggling and nonstruggling students from control schools when fall scores were controlled for. Such an expectation was based on the idea that professional development in reading development and diagnostic instruction for teachers would benefit all students within those classrooms. Third, we hypothesized that there would not be a differential effect of TRI based on students' baseline receptive vocabulary scores. However, we felt this was a hypothesis that warranted testing because other researchers (e.g., Torgesen et al., 1999) have demonstrated how other early reading interventions had little effect for students with the lowest language abilities. In addition, other studies have demonstrated the strong relationship between early vocabulary and later reading, also suggesting that poorer vocabulary might prevent children from profiting from classroom reading instruction (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003).

Early Reading Development and TRI Framework

Reading researchers have identified specific characteristics of children as they start school that are likely to lead them to struggle or not to struggle with reading early in school. Most notably, weaker oral language abilities, limited exposure to reading and print, and poorer phonemic awareness and phonics knowledge are all related to poorer reading achievement (National Institute of Child Health and Development [NICHD], 2000; Storch & Whitehurst, 2002). Children from low-income, minority, rural, or urban families are particularly vulnerable for early reading difficulties (e.g., Hart & Risley, 1995; Lee & Burkam, 2002; Vernon-Feagans, Gallagher, & Kainz, 2009). A common shorthand for thinking about these reading requisites is to reduce them to print-driven, word-level abilities and broader oral (and later written, text-level) language abilities (e.g., Scarborough, 2001).

TRI Reading Model

In the TRI reading model, we have attempted to simplify and capture how early reading develops, and sometimes fails to develop, with a model derived primarily from the consensus findings of the *National Reading Panel Report* (NICHD, 2000) and *Preventing Reading Difficulties in Young Children* (Snow et al., 1998). The model arose from a perceived need to support teachers' overall conceptualization of the reading process, especially its early development. The TRI reading model highlights the centrality of reading comprehension as the ultimate goal of early reading instruction while also showcasing several interrelationships among other important reading subprocesses. These cognitive subprocesses of word identification, fluency, vocabulary, and comprehension also interact with a more affective aspect of reading termed motivation and engagement, which we believe merits particular attention for struggling beginning readers (Snow et al., 1998).

The TRI Instructional Framework for Students

The key reading research reports (described above) along with more current reading research (e.g., Connor, Morrison, Fishman, Schatschneider, & Underwood, 2007) that examined relationships among child characteristics and teacher instruction guided the formation of the TRI's instructional framework for students. In each classroom, the classroom teacher targets one struggling student, usually for several weeks at a time, to provide diagnostically driven reading instruction in which children learn about the alphabetic code and the meaning-making nature of reading in the context of real words and books. While other students are working at literacy centers, working independently, or receiving instruction from a teaching assistant, the teacher guides the student one-on-one for about 15 to 20 minutes through a three-component lesson: Re-Reading for Fluency (2–5 minutes), Word Work (6–10 minutes), and Guided Oral Reading (7–10 minutes). These lessons are thorough enough to make gains on a daily basis (Petursdottir et al., 2009; Savage, Carless, & Stuart, 2003) but not as long as other pull-out interventions (e.g., Clay, 1993; Morris et al., 2000) because of the classroom teacher's other responsibilities. For each component, we suggest a typical procedure, yet we place greater emphasis on optimal teacher responses to typical student errors (Brown, 2003; Rodgers, 2004/2005). TRI is guided by diagnostic instructional strategies geared to individual students' instruc-

tional needs, and therefore teachers rely on diagnostic information from each day's TRI session to plan for subsequent TRI instruction (Clay, 1993). Such systematic classroom-based reading intervention differentiates the experiences of a struggling reader receiving TRI versus a struggling reader in a control classroom and is further detailed below.

After a child who received one-on-one TRI instruction has accelerated sufficiently to be able to better learn from the general classroom environment, the teacher selects another student to receive individualized instruction, which allows that teacher to target the instructional and emotional needs of up to five struggling readers across the year. In addition, after working with children in this one-on-one setting initially, a TRI teacher may elect to work with them in groups of two or three if they have similar diagnostic needs.

Re-Reading for Fluency. In the first TRI component, Re-Reading for Fluency, the teacher asks the student to reread a selection, which the student has read at least once the previous day, at his or her independent reading level (Samuels, 1979) for the purpose of developing word identification automaticity and reading fluency. During this component the teacher might also model fluent, expressive reading with some or all of the text, depending on the skill level of the child. This instructional activity embraces the research base that validates repeated reading of text with teacher feedback (Kuhn & Stahl, 2003) as well the importance of building a child's motivation to read (Snow et al., 1998).

Word Work. The second component of TRI, Word Work, provides the teacher with a small collection of diagnostically driven strategies for helping the child manipulate, say, and write words and text for the end goal of phonological decoding and sight word recognition (Bear, Invernizzi, Templeton, & Johnson, 2008; McCandliss, Beck, Sandak, & Perfetti, 2003; C. McGuinness, McGuinness, & McGuinness, 1996; D. McGuinness, 1997; Moats, 1998; Morris et al., 2000). Instead of designing the instructional sequence in a step-wise, bottom-up manner, TRI Word Work strategies synergistically and efficiently integrate multiple word-identification subprocesses simultaneously so that the connection for the child between the activity and the end purpose of reading meaningful words and text is explicit. Thus, instead of first teaching oral phonological awareness, letter name knowledge, and word-to-word matching before or separate from decoding or phonics knowledge instruction, the TRI Word Work strategies integrate (*a*) a demonstration of the alphabetic principle, (*b*) phoneme-grapheme (sound-symbol) relationships, (*c*) phonemic segmenting and blending abilities, (*d*) decoding practice, (*e*) sight word practice, and, later, (*f*) how to "chunk" and read multisyllabic words.

TRI Word Work aligns well with the current research base on optimal instructional practices (Adams, 1990; NICHD, 2000; Snow et al., 1998). The teacher systematically displays phonics information for the child to acquire and explicitly links phonemic segmenting and blending tasks with letter sounds (McCandliss et al., 2003; NICHD, 2000). Teachers keep the instructional time motivating (Snow et al., 1998) by moving quickly from one activity to the next, matching the instruction to the child's demonstrated need (Connor, Morrison, & Katch, 2004), and offering intensive instructional and emotional support (Hamre & Pianta, 2005; Pianta, 2006). Through the teachers' coaching, the Word Work activities also help readers develop the subprocesses necessary for phonological decoding so that they can become more

independent at attacking unknown words, as proposed by Share's (1995) self-teaching mechanism.

Guided Oral Reading. During the third component of the TRI, Guided Oral Reading, the teacher employs strategies to scaffold a child's oral reading of an instructional-level text. The teacher provides comprehension strategy instruction and support as well as word-identification and vocabulary support built on the TRI Word Work sessions. Teachers pay particular attention to scaffolding children's abilities to summarize, predict, make connections, and make inferences through interactive coaching before, during, and after the reading, which reflects recommendations from consensus documents about text comprehension (NICHD, 2000; Snow et al., 1998). Teacher-led yet child-responsive dialogue about a book every session provides a natural environment for the teacher to prompt and the child to practice and internalize relevant comprehension strategies (Snow et al., 1998). Instruction and text selection are closely matched to the individual student's current need; these measures have been found to motivate readers (Snow et al., 1998). Teachers also focus on word-level, moment-by-moment coaching for word identification and vocabulary knowledge (Brown, 2003; Rodgers, 2004/2005) in addition to the traditional guided oral reading focus on text-level comprehension.

Contexts Related to the Current Study

Technology use in teacher development. In recent years, technological tools have started being more widely used in education, both with students (e.g., Fox, 2009) and for teachers' professional development (e.g., Gentry, Denton, & Kurz, 2008). Although there are many empirically based studies on Web-based professional development and learning, research findings on technologically facilitated teacher professional development using webcams are in their infancy. Selected studies have highlighted issues related to effective technology use in professional development. Kao and Tsai (2009) demonstrated that teachers' beliefs about Web-based learning were related to their attitudes about Web-based professional development, highlighting an important potential prerequisite for technologically facilitated professional development. Gentry and colleagues (2008) conducted a research synthesis of existing peer-reviewed studies on technologically mediated coaching. Results suggested that teachers who received technologically facilitated coaching reported positive experiences and shifts in attitudes toward changes in instructional practices. However, very little of the teacher-reported data from the reviewed studies were validated through direct observation. Gentry and colleagues suggested the need for more rigorous qualitative and quantitative research, particularly experimental and quasiexperimental studies. In addition, Gentry and colleagues were unable to locate any studies for their review that investigated the relationship between coaching of teachers and student outcome data.

Professional development. Each component of the TRI professional development process was based on current evidence on professional development. Specifically, researchers have suggested that (*a*) more extensive content knowledge is related to more effective teaching (e.g., Carreker et al., 2005); (*b*) effective professional development should be integrated with teachers' daily work and school lives, especially as teachers attempt new or reformed classroom practices (Scanlon, Gelzheiser, Vellutino, Schatschneider, & Sweeney, 2008; Taylor, Pearson, Peterson, & Rodri-

guez, 2005); (*c*) professional development should promote site-based learning communities working toward common goals, often driven by student assessment data (Guskey, 2003; Taylor & Pearson, 2004; Taylor et al., 2005); and (*d*) professional development is most effective with strong leadership and external support (Scanlon et al., 2008; Taylor et al., 2005).

To date, the empirical research on the effects of literacy coaching for classroom teachers is in the early stages; however, results from recent studies have demonstrated the efficacy of such coaching. Scanlon et al. (2008) examined whether kindergarten classroom teachers could effectively implement the Interactive Strategies Approach (ISA; Vellutino & Scanlon, 2002) through coaching. In a comparison of three different implementation types, including a pull-out model, they found that the classroom teacher, with coaching across the year, significantly reduced the number of children at risk for reading failure. Researchers from another study found that coaching was as beneficial as traditional workshop- or institute-based professional development (Garet et al., 2008), while others have demonstrated effective coach-teacher conversations (Peterson, Taylor, Burnham, & Schock, 2009), the complexity of literacy coaches' roles (Walpole & Blamey, 2008), and the challenges faced by literacy coaches (Al Otaiba, Hosp, Smartt, & Dole, 2008).

The context of low-wealth, rural schools. As a group, children who live in poverty are at the highest risk for failure in learning how to read (Snow et al., 1998; Vernon-Feagans et al., 2009). Poor and rural children may be at even greater risk, because rural children are poorer than most urban children, and rural children may come to school with fewer emergent literacy skills than other children (Lee & Burkam, 2002; Vernon-Feagans, Odom, Panscofar, & Kainz, 2008). While it may be particularly important for students in poor rural areas who are struggling readers to be provided with effective instruction, teachers from poor rural areas are often geographically isolated and are less likely to receive enhanced professional development and instructional practice (Government Accountability Office, 2004), creating barriers for optimal teaching practices. On the other hand, rural communities provide a strong base for successful educational programs because of the more stable, supportive, and safe home/neighborhood environments that promote development (Vernon-Feagans et al., 2009). By capitalizing on the strengths of rural communities, successful, cost-effective educational interventions can promote better educational achievement for their struggling learners. One important avenue to help with these barriers is to provide access to professional development at low cost through educational technology such as the TRI, which employs laptop computers and webcams in the regular classroom for distance coaching from remote, highly qualified literacy coaches.

Method

Study Context

Eight schools from five school districts in the southwestern United States participated in the study. Two schools were the only elementary schools within their districts. Because of the small number of schools, when possible, schools within each district were paired based on demographic characteristics (school size, race/ethnic composition, Reading First participation, and percentage of students eligible for free

Table 1. Demographics of Teachers ($n = 43$)

	Experimental			Control		
Variable	*N*	*M*	*SD*	*N*	*M*	*SD*
Race:						
Black/African American	2			2		
White/European American	23			12		
Other (3)/missing (1)	1			3		
Gender:						
Female (1 missing treated)	25			17		
Age:						
20–29	5			5		
30–39	6			5		
40–49	8			5		
50–59	7			1		
60+	0			1		
Certification level:						
Elementary ed. certified	23			15		
Master's degree or higher	11			4		
Experience:						
Total years teaching		15.29	9.35		9.62	7.11
Total years teaching current grade		7.63	6.22		5.38	3.99
Total years teaching at current school		7.31	4.79		7.38	7.25
Total years teaching in current county		11.19	8.25		8.24	7.22

or reduced-price lunch) and randomly assigned to the experimental or control condition. The two single-school districts were matched and randomly assigned in the same manner. After random assignment, difficulties with technology—specifically, the lack of district-level technology staff to troubleshoot initial firewall issues—led to the withdrawal of one experimental school. The seven remaining participating schools included 43 classrooms, 26 experimental and 17 control. Nineteen kindergarten classrooms and 24 first-grade classrooms participated, and all experimental classrooms received and used the same professional development, materials, and TRI instruction. All eight schools received Title I funding, which was used to reduce class size and fund other positions (National Center for Education Statistics, 2008). Teacher demographics are presented in Table 1, and, consistent with literature on rural schools, teachers were very experienced but had less advanced education than teachers in more urban areas (Lee & Burkam, 2002).

Overall, students in the study were diverse. Minority students comprised 56.7% to 98.3% of the students in the schools, and most of the students (56.7%–78.4%) were eligible for free or reduced-price lunch (National Center for Education Statistics, 2008). Statewide achievement tests at all schools reflected typical achievement gaps between Caucasian and minority students.

Procedures and Participants

Kindergarten and first-grade children in the experimental and control schools were initially eligible for the study if they were not diagnosed with a severe disability and spoke at least some conversational English. These criteria excluded few children

in the classrooms. Using a two-step process, the classroom teacher and one of the TRI literacy coaches determined further eligibility. First, teachers administered any state- or district-mandated kindergarten or first-grade assessments of emergent reading skills along with any informal classroom assessments.

Second, based on all available assessment data from the first step and the teacher's knowledge of each child's progress in school, TRI literacy coaches guided each teacher through a process to rank each child in the classroom using a TRI Screening Instrument. The TRI Screening Instrument is a one-page instrument on which teachers first ranked students from lowest performance to highest performance based on state- or district-mandated assessments of reading skills. Second, the teacher rated whether each child was currently (*a*) benefiting from regular classroom instruction and (*b*) below, at, or above grade level. Based on each teacher's TRI Screening Instrument, two groups of students were created—those rated below grade level and those rated at or above grade level. From among the students in each class who were rated below grade level and were struggling with learning to read, the research team randomly selected five as *focal* children. From among those students rated at or above grade level and benefiting from regular classroom instruction, the research team randomly selected five as *nonfocal* children. Groups of focal and nonfocal students were selected in both the experimental and the control schools. Thus, each experimental and control classroom contained five focal students and five nonfocal students, a total of 10 students per classroom. Limited resources, as well as prior research experiences (Vernon-Feagans et al., 2010), precluded the inclusion of greater numbers of students from each classroom. Focal children in the experimental schools received TRI from October to May of the academic year. Focal and nonfocal children in control schools as well as the nonfocal children in the experimental schools received regular classroom instruction in reading based on state, district, and school objectives and standards. Table 2 shows the demographics for the four groups of students in the study: experimental focal, experimental nonfocal, control focal, and control nonfocal.

TRI Via Distance Technology

We employed an innovative distance technology model to deliver professional development and real-time literacy coaching to isolated rural schools. Each experimental classroom received a laptop, webcam (Logitech QuickCam Orbit), and Web-conferencing software (Polycom PVX). This technology was used with the experimental teachers so that we could see and hear them working with each of their struggling readers in real time, and they could see and hear the TRI literacy coaches at our university. Through this technology our literacy coaches could provide coaching for the classroom teacher in implementing the TRI strategies. In addition, the technology was employed for grade-level meetings and additional workshops throughout the year. The technology cost less than $1,300 per classroom.

Three TRI literacy coaches worked with the teachers in the present study. All were female and former primary-grades classroom teachers possessing master's degrees and state literacy specialist certification. One coach had worked with TRI for 2 years prior to the current study, and the other two began approximately 4 months prior to the current study. All three coaches were both content specialists in terms of TRI and

Table 2. Demographics of the Children ($n = 364$)

	Experimental Focal ($n = 112$)		Experimental Nonfocal ($n = 125$)		Control Focal ($n = 63$)		Control Nonfocal ($n = 64$)	
Variable	*n*	%	*n*	%	*n*	%	*n*	%
Race:								
Black/African American	28	25.93	30	24.00	25	39.68	8	12.50
American Indian	0	0	2	1.60	0	0	3	4.69
White/European American	44	39.29	45	36.00	11	17.46	31	48.44
Other	34	30.36	46	36.80	23	36.51	22	34.38
Gender:								
Female	44	39.29	71	56.80	25	39.68	33	51.56
Male	68	60.71	54	43.20	38	60.32	31	48.44
Grade:								
K	60	53.57	54	43.20	28	44.44	26	40.63
1	52	46.43	67	53.60	34	53.97	38	59.38
Mother's education:								
Eigth grade or less	8	7.14	4	3.20	2	3.17	1	1.56
Some high school	9	8.04	11	8.80	9	14.29	5	7.81
Diploma or GED	32	28.57	39	31.20	25	39.68	13	20.31
Some college or associate's degree	38	33.93	34	27.20	21	33.33	25	39.06
Bachelor's degree	12	10.71	19	15.20	2	3.17	14	21.88
Graduate school	2	1.79	9	7.20	1	1.59	3	4.69

Note.—Counts or percents may not add to 100 due to missing data.

had prior experience working with teachers, and were also comfortable with technology and the distance model.

Initially there were frequent firewall concerns at each of the rural schools. University-based technology support staff contacted each school district and building to work with district or school personnel to address issues related to firewall access for the two-way audio and video. To facilitate school firewall access, teachers and school personnel always initiated the Web-conference calls to TRI personnel. Ongoing concerns were addressed at two schools by switching to Skype videoconferencing software.

The TRI strategies were delivered through an ongoing literacy-coaching model delivered primarily via distance technology geared to the contexts of isolated rural schools. The TRI provided classroom teachers with a trained university-based TRI literacy coach and an on-site consultant from the school faculty to facilitate TRI implementation, using a community-of-practice approach (Wenger, 1998) designed to promote teacher ownership of the TRI process that would sustain the intervention in the rural context. Although a community-of-practice approach may seem counterintuitive with members at a great geographical distance, we conceptualized such an approach based on Wenger's definition of a community of practice as a group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. Through a shared concern for addressing the needs of struggling readers, school-based personnel (classroom teachers, the on-site consultant, and school administrators) and the TRI literacy coach comprised a group

with a shared concern and regularly interacted through TRI professional development activities to improve reading instruction.

Four key professional development activities facilitated the learning and the development of a community of practice for the K–1 classroom teachers and on-site consultant: (1) a face-to-face summer institute that included classroom teachers, on-site consultants, and school principals; (2) weekly/biweekly literacy coaching "visits" during TRI sessions via real-time Web conferencing with each classroom teacher by the TRI literacy coach; (3) weekly real-time Web-conferencing grade-level meetings about individual children's reading performance and progress; and (4) monthly/bimonthly 2-hour real-time Web-conferencing professional development sessions designed to meet needs expressed by the classroom teachers. Each of these activities is detailed below.

The 3-day summer institute introduced K–1 teachers, on-site consultants, and school principals to TRI content through interactive large- and small-group sessions that included practicing the strategies through role-play and using problem-solving strategies with struggling readers' case studies. Small-group discussions laid the groundwork for the preparation of classrooms prior to the beginning of school so TRI could be implemented in the early fall.

The remaining TRI professional development activities were conducted via real-time Web-conferencing technology and are described in subsequent paragraphs. Each kindergarten and first-grade teacher was supplied with a laptop computer, and a webcam and Web-conferencing software were installed in each classroom. Each TRI literacy coach had an identical system that allowed real-time, secure, two-way audio and video communication between each K–1 classroom and the assigned TRI literacy coach. With this system the TRI literacy coach was able to see, hear, and interact with the classroom teacher and her student during TRI instruction, and vice versa.

The weekly/biweekly literacy coaching Web-conference visits had two foci. First, TRI literacy coaches observed classroom teachers working with a struggling reader in a TRI session and gave real-time feedback and coaching. During these sessions, as often as possible, on-site consultants were present in classrooms to observe and participate in the literacy coaching process. During TRI sessions, TRI literacy coaches (*a*) provided coaching and feedback during the TRI lesson, (*b*) observed the lesson and gave feedback immediately following the lesson, or (*c*) did both, depending on each teacher's preferences and interaction style. Immediately following the TRI session, as time permitted, TRI literacy coaches and classroom teachers debriefed about the observed session and problem-solved future TRI instruction for the specific struggling reader. Second, the TRI literacy coach supported the on-site consultant as the consultant assumed the major responsibilities of the literacy coaching process. On-site consultants included a school curriculum coordinator, reading specialists, and a school principal.

Weekly real-time Web-conferencing grade-level meetings facilitated the creation of a professional learning community that problem-solved about targeted students' literacy needs. These weekly meetings of 30 minutes or less were focused on TRI implementation with focal students and allowed each teacher to present a case analysis of a focal student receiving TRI instruction. All on-site consultants and classroom teachers collaboratively problem-solved to address focal students' reading needs through TRI instruction and strategies.

Finally, the TRI professional development process via distance technology provided monthly/bimonthly 2-hour, real-time Web-conferencing professional development sessions designed to meet needs expressed by the classroom teachers. The monthly 2-hour sessions (or bimonthly 3.5-hour sessions) included additional and advanced TRI strategies and content as well as content the classroom teachers thought would be helpful in the implementation of TRI, including new ideas for extending the learning during independent work and honing the diagnostic thinking process.

Procedure and Measures

All children in the study were administered a battery of standardized tests in the fall and spring of the school year. Teachers filled out questionnaires about their professional background and classroom. All child assessments were done in the schools in a quiet room. Trained university faculty and graduate students from southwestern universities conducted the child assessments. The assessors had previous testing experience and participated in a 2-day training, which included the administration of the complete battery with nonparticipating students. Assessors were not informed which schools were experimental or control. The following measures were administered to children in the fall and the spring.

Four subtests of the Woodcock-Johnson Diagnostic Reading Battery, III (WJ-DRB, III; Woodcock, Mather, & Schank, 2004) were administered to all children. The first subtest, Word Attack, measures skill in applying phonic and structural analysis skills to the pronunciation of unfamiliar printed sounds and words. The initial items require the child to produce sounds for single letters. The remaining items require the child to read aloud letter combinations that are phonetically consistent, or regular, patterns in English orthography but are nonwords or low-frequency words. Word Attack has a median reliability of .87 in the 5–19 age range (Woodcock et al., 2004).

The second subtest, Letter/Word Identification, measures the child's word-identification skills. The initial items require the child to identify letters that appear in large type, and the remaining items require the child to pronounce words correctly. The child is not required to know the meaning of any words. Letter/Word Identification has a median reliability of .91 in the 5–19 age range (Woodcock et al., 2004).

In the third subtest, Passage Comprehension, initial items measure symbolic learning and require the child to match a rebus with an actual picture of an item. The remainder of the subtest items employ a modified cloze procedure that requires the child to read a short passage and provide a missing key word that makes sense within the context of the passage. The items become increasingly difficult by removing pictorial support and by increasing passage length, level of vocabulary, and passage difficulty. Passage Comprehension has a median reliability of .83 in the 5–19 age range (Woodcock et al., 2004).

The fourth subtest, Spelling of Sounds, measures the child's spelling ability, in particular, phonological and orthographical coding skills. Initial items require the child to write single letters for sounds. Remaining items require the child to spell letter combinations that are regular patterns in English spelling, and all items are

nonsense or low-frequency words. Spelling of Sounds has a median reliability of .74 in the 6–19 age range (Woodcock et al., 2004).

The Peabody Picture Vocabulary Test—Third Edition (PPVT-III; Dunn & Dunn, 1997) is an individually administered, norm-referenced test of receptive vocabulary knowledge. Children are asked to select the picture from among four black-and-white illustrations presented that best represents the meaning of the stimulus word presented orally by the examiner. Alpha coefficients for the PPVT-III for elementary-age students range from .92 to .95 (Dunn & Dunn, 1997).

Duration of Intervention and Quality of TRI Instruction

To assess implementation of the TRI, a TRI Intervention Duration and Quality Measure was used to assess duration and quality of TRI instruction for each struggling student eligible for TRI instruction. Duration of the TRI and quality of instruction were rated using two separate 5-point Likert scales. The first scale assessed the duration of TRI intervention, and the second the quality of TRI instruction. The duration scale reflected the total number of weeks a struggling student eligible for TRI received TRI instruction and was reported by teachers in their regular meetings with TRI literacy coaches. A rating of 1 indicated no weeks of TRI intervention, 3 indicated 4 to 9 weeks of total TRI intervention, and 5 indicated 19 weeks or more of total TRI intervention. The quality of TRI instruction scale rated the classroom teachers' use of diagnostic assessing/planning tools and faithfulness to TRI strategies for each struggling student eligible for TRI instruction as assessed by the TRI literacy coaches. The TRI literacy coaches used anchor points to guide the rating of individual classroom teachers. These included the following: (*a*) regular use of the TRI (at least 15 minutes/four times per week), (*b*) use of diagnostic assessing/planning tools, and (*c*) faithfulness to the TRI strategies. A score of 1 indicated little or no instruction akin to the TRI, and 3 indicated at least moderate quality of TRI instruction at least twice a week, using at least two of the three components (fluency, word work, or guided oral reading), using some of the diagnostic tools available in the TRI. A rating of 5 indicated high-quality TRI instruction at least four times a week, including all three major components, with consistent use of the TRI diagnostic tools.

TRI literacy coaches completed the TRI Intervention Duration and Quality Measure in the spring using observation and weekly records on classroom teacher implementation. The duration scale and quality of TRI instruction scale were combined to form a total implementation scale composite that was the average of the two scales combined.

The mean total implementation scale composite score for struggling students in the experimental condition was 3.41, with a standard deviation of .87. Specifically, 34.82% received TRI with high implementation (total implementation scale = 4 or greater), 50.00% received TRI with moderate implementation (total implementation scale = 3–3.99), 9.82% received TRI with low implementation (total implementation scale = 2–2.99), and 5.36% received TRI with very low implementation (total implementation scale = less than 2).

Analysis Strategy

Based on the experimental design, we performed an intent-to-treat analysis. We defined four groups of children for analysis purposes and to test hypotheses about

the effectiveness of the TRI: experimental focal (struggling students in TRI classrooms), experimental nonfocal (nonstruggling students in TRI classrooms), control focal (struggling students in non-TRI classrooms), control nonfocal (nonstruggling students in non-TRI classrooms).

To avoid imprecise estimation due to missing data, multiple imputed datasets were analyzed in SAS v9.1. The multiple imputation method was conducted under an unstructured normal model assuming data are missing at random (Shafer & Graham, 2002). Five imputed data sets were created using a set of relevant variables to generate imputed values. Models were run on each of the five imputed data sets, and parameters were aggregated across the data sets.

Intent-to-treat models were used to examine the effect of experimental status on children's spring performance in Letter/Word Identification, Word Attack, Passage Comprehension, and Spelling of Sounds, controlling for performance in the fall. Additionally, these ANCOVA models controlled for child race, child gender, child grade, fall PPVT scores, treatment status, and the interaction term representing treatment-effect variation due to baseline PPVT scores. All covariates except for treatment status were centered for analysis. All models were estimated as hierarchical linear models (HLMs) in SAS v9.1 to account for the nested structure of the data. We estimated random intercepts for classrooms and allowed for school-specific variation between classrooms within schools.

To evaluate the TRI distance intervention effect, omnibus ANCOVA models were followed up with a set of planned contrasts for each outcome: conditional spring performance for experimental focal schools compared to conditional spring performance for control focal schools, conditional spring performance for all experimental schools compared to conditional spring performance for all control schools, and the interactive effect of baseline PPVT scores on the differences in conditional spring performance between experimental focal and control focal schools.

Results

Prior to the ANCOVA models, an examination of potential pretest differences between both experimental focal and control focal students and experimental and control schools was conducted. The ANCOVA model is typically a powerful and unbiased method to detect treatment effects when assignment is random. However, the random assignment assumes equivalent groups at pretest. Table 3 demonstrates that pretest scores did not differ significantly for the experimental focal and control focal groups. The proportion of white students did vary significantly across groups, but that variable was added to the HLMs to control for any baseline differences. At the school level, pretest scores differed significantly for Letter/Word Identification and Spelling of Sounds, which is often the case when a small number of units is randomized. However, the ANCOVA specification adjusts posttest scores on the pretests and essentially models variation in posttest scores holding pretest scores equivalent across individuals.

Table 4 contains unweighted mean *W* scores and standard deviations for the four outcome variables by the four intent-to-treat groups before accounting for the covariates, as well as standardized PPVT scores. Woodcock Johnson *W* scores were used for analyses, since many of the children scored near the floor on the WJ-DRB, III, and *W* scores were appropriately scaled for longitudinal analysis. The *W* scale has

Table 3. Statistical Tests of Baseline Differences Between Experimental Focal vs. Control Focal Students and Experimental vs. Control Schools

	Experimental Focal Mean (*SD*)	Control Focal Mean (*SD*)	Test of Mean Difference
Fall Word Attack	435.65 (28.41)	430.44 (30.05)	$t = -1.11$, $p = .27$
Fall Letter-Word Identification	384.03 (32.98)	376.49 (35.25)	$t = -1.38$, $p = .17$
Fall Passage Comprehension	416.40 (24.00)	416.92 (19.75)	$t = .14$, $p = .89$
Fall Spelling	468.95 (21.79)	462.58 (26.27)	$t = -1.68$, $p = .10$
Mother's education	12.85 (2.25)	12.5 (1.86)	$t = -1.02$, $p = .31$
	Experimental Focal (%)	Control Focal (%)	χ^2 Test of Proportional Difference
White	39.29	17.46	$\chi^2(1) = 9.44$, $p = .004$
Male	60.71	60.32	$\chi^2(1) = .003$, $p = .96$
	Experimental School Mean (*SD*)	Control School Mean (*SD*)	Test of Mean Difference
Fall Word Attack	443.13 (28.67)	437.20 (28.87)	$t = 1.85$, $p = .07$
Fall Letter-Word Identification	395.11 (36.42)	384.93 (34.01)	$t = 2.55$, $p = .01$
Fall Passage Comprehension	424.11 (28.63)	419.55 (23.55)	$t = 1.52$, $p = .13$
Fall Spelling	474.67 (19.85)	468.88 (24.26)	$t = 2.41$, $p = .02$
Mother's education	13.13 (2.33)	13.16 (2.09)	$t = -.09$, $p = .93$
	Experimental School (%)	Control School (%)	χ^2 Test of Proportional Difference
White	37.60	33.10	$\chi^2(1) = 8.47$, $p = .00$
Male	51.50	54.30	$\chi^2(1) = .27$, $p = .60$

mathematical properties (e.g., equal interval units) that make it well suited for use in the interpretation of test performance. For each of the WJ-DRB, III, outcome analyses, beta coefficients, standard error estimates, *p* values, and effect sizes (δ) are

Table 4. Unweighted Mean *W* Scores (*SD*) for Word Attack, Letter-Word Identification, Spelling of Sounds, and Passage Comprehension, and PPVT Standard Scores by the Four Intent-to-Treat Groups

	Experimental Focal ($N = 108$)	Experimental Nonfocal ($N = 119$)	Control Focal ($N = 59$)	Control Nonfocal ($N = 64$)
Fall scores:				
Word Attack	435.65 (28.41)	449.92 (27.28)	430.44 (30.05)	443.42 (26.46)
Letter-Word Identification	384.03 (32.98)	405.26 (36.60)	376.49 (35.25)	392.72 (31.10)
Passage Comprehension	416.40 (24.00)	431.18 (30.74)	416.92 (19.75)	421.98 (26.15)
Spelling of Sounds	468.95 (21.79)	479.86 (16.34)	462.58 (26.27)	474.69 (20.82)
PPVT	88.39 (13.99)	94.59 (13.17)	86.24 (15.02)	96.56 (15.16)
Spring scores:				
Word Attack	467.26 (20.11)	474.47 (21.50)	457.15 (23.34)	468.52 (20.18)
Letter-Word Identifcation	425.56 (28.58)	441.66 (32.87)	411.39 (32.06)	429.58 (31.45)
Passage Comprehension	443.69 (23.62)	457.54 (24.45)	432.94 (27.82)	447.58 (27.18)
Spelling of Sounds	489.74 (9.48)	492.87 (9.82)	484.61 (14.26)	491.26 (11.78)
PPVT	91.81 (13.29)	97.91 (15.04)	90.57 (14.12)	100.18 (16.41)

Table 5. ANCOVA Results for Work Attack, Letter Word Identification, Passage Comprehension, and Spelling of Sounds

	Word Attack				Letter-Word Identification				Passage Comprehension				Spelling of Sounds			
Effect	*B*	*SE*	*p*	δ	*B*	*SE*	*p*	δ	*B*	*SE*	*p*	δ	*B*	*SE*	*p*	δ
White	.10	1.83	.96		1.68	1.93	.38		1.13	1.93	.56		.87	.97	.37	
Male	−5.87	1.70	.00		−4.31	1.72	.01		−3.22	1.68	.06		−1.38	.87	.12	
Mother's education	−.17	.48	.73		.38	.43	.38		.65	.45	.15		.20	.26	.45	
Grade	3.53	2.82	.21		16.38	3.38	<.0001		28.23	2.60	<.0001		2.93	1.62	.07	
PPVT	.32	.11	.00		.26	.11	.01		.31	.11	.01		.06	.06	.26	
Planned contrasts:																
Experimental focal vs. control focal	10.42	3.13	.00	.52	10.69	3.18	.00	.52	13.03	2.91	<.0001	.72	3.75	1.56	.02	.40
Experimental school vs. control school	7.12	2.28	.00	.35	6.93	2.68	.01	.34	11.08	2.34	<.0001	.61	2.16	1.17	.07	
PPVT × experimental focal vs. control focal	−.02	.17	.89		−.12	.17	.48		.00	.16	.98		−.15	.09	.08	

reported along with contrast estimates in Table 5. Effect sizes of .2 are interpreted as small, .5 as medium, and .8 as large (Cohen, 1988). The following covariates were included in each of the models to reduce error variance: race (whether a student was white), gender (whether a student was male), mother's education level (as a proxy for socioeconomic status), grade, and fall PPVT score. Since covariates were not of interest with respect to the research questions, significant covariate effects are not interpreted below. However, covariate results are contained in Table 5.

Word Attack

Experimental focal students had significantly higher conditional spring Word Attack performance than control focal students ($p < .01$, $\delta = .52$). For this medium effect size, the advantage for experimental focal students was approximately 10 *W* score points, which was close to one-half standard deviation in observed spring *WA* scores ($SD = 21.86$). On average, experimental school students had significantly higher conditional spring scores than control school students overall ($p < .01$, $\delta = .35$), and the magnitude of this difference was approximately seven *W* score points, a small effect size. There was no evidence for a baseline PPVT interaction on Word Attack between experimental focal and control focal students ($p > .88$).

Letter/Word Identification

Experimental focal students had significantly higher conditional spring Letter/Word Identification performance than control focal students ($p < .01$, $\delta = .52$). For this medium effect size, the advantage for experimental focal students was approxi-

mately 11 *W* score points, which is approximately one-third standard deviation in observed spring Letter/Word Identification scores ($SD = 32.8$). On average, experimental school students had significantly higher conditional spring scores than control school students overall ($p < .02$, $\delta = .34$), and the magnitude of this difference was approximately seven *W* score points, a small effect size. There was no evidence for a baseline PPVT interaction in Letter/Word Identification gains between experimental focal and control focal students ($p > .47$).

Passage Comprehension

Experimental focal students had significantly higher conditional Passage Comprehension spring performance than control focal students ($p < .001$, $\delta = .72$). For this medium to large effect size, the advantage for experimental focal students was approximately 13 *W* score points, which is close to one-half standard deviation in observed spring Passage Comprehension scores ($SD = 26.7$). On average, experimental school students had significantly higher conditional spring Passage Comprehension scores than control school students overall ($p < .001$, $\delta = .61$), and the magnitude of this difference was approximately 11 *W* score points, a medium effect size. There was no evidence for a baseline PPVT interaction in Passage Comprehension between experimental focal and control focal students ($p > .98$).

Spelling of Sounds

Experimental focal students had significantly higher conditional Spelling of Sounds spring performance than control focal students ($p < .03$, $\delta = .40$). For this small to medium effect size, the advantage for experimental focal students was approximately four *W* score points, which is less than one-third standard deviation in observed spring Spelling of Sounds scores ($SD = 32.8$). There was no significant difference in conditional spring Spelling of Sounds performance scores for experimental school students and control school students ($p > .06$). There was no evidence for a baseline PPVT interaction on Spelling of Sounds between experimental focal and control focal students ($p > .07$).

Conclusions and Discussion

Conclusions

The main findings from this study supported our hypotheses about the effectiveness of TRI. First, struggling focal kindergarten and first-grade students who received TRI significantly outperformed struggling focal students from control schools on all spring reading outcomes after controlling for fall scores. Specifically, struggling students who received the TRI ended the year with significantly higher Word Attack, Letter/Word Identification, Passage Comprehension, and Spelling of Sounds scores than their struggling peers who did not receive TRI. The effect sizes for the reading outcomes ranged from .40 to .72, with most effects resulting in a shift of one-half standard deviation advantage for the focal experimental children over the focal control children in the spring. These findings demonstrate the positive relationship between receiving TRI and children's reading performance across a variety of reading domains. Second, all students (both struggling and nonstruggling) in TRI

schools had higher selected reading outcomes than students (both struggling and nonstruggling) from control classrooms after controlling for initial performance. Specifically, students in TRI schools ended the year with significantly higher Word Attack, Letter/Word Identification, and Passage Comprehension scores than students from control schools. The effect sizes for the experimental versus control schools ranged from .34 to .61, slightly lower than the effect sizes for the experimental focal (struggling) versus the control focal (struggling) children. Such findings demonstrate a positive relationship between teachers' participation in TRI and children's reading performance across a variety of reading domains. Finally, there was no differential impact of TRI on struggling students' reading outcome scores based on beginning-of-the-year receptive vocabulary scores.

Discussion

The results from this study support previous work that suggested struggling readers in early elementary school can be helped by specific focused interventions. A considerable amount of research, funding, and instructional time has been invested in creating and implementing such early reading interventions for struggling students (e.g., Clay, 1993; Morris et al., 2000; Shanahan & Barr, 1995; Slavin et al., 1996). Yet most of these efforts have employed specialized teachers/tutors/special educators to implement the particular intervention to help struggling readers. Although effective, many of these interventions are costly and less sustainable when the studies are completed. In addition, we recognize that the current study did not investigate which TRI components might be particularly effective; however, we felt it was important to consider potential explanations for the results of our analyses, and we do so in selected parts of the current section and the section on follow-up research studies.

To our knowledge, this is one of the few studies that has demonstrated that classroom teachers can successfully implement an intervention with struggling readers. Like Scanlon and colleagues (2008), who reported that classroom teachers could accelerate at-risk kindergarten students' Word Attack and Letter/Word Identification skills with consultation from skilled literacy coaches, we also found that classroom teachers were effective at providing reading intervention instruction. Our findings complement Scanlon and colleagues' findings of effects on word-level skills, because unlike many other studies, TRI appeared to impact a broad range of reading skills, including letter and word identification, decoding, spelling, and reading comprehension.

Many early reading interventions, which contain a significant instructional focus on phonological processes, have failed to show effects—or have had small to moderate effects—on reading comprehension compared to word-level reading skills (Blachman et al., 2004; Foorman, Francis, Fletcher, Mehta, & Schatschneider, 1998; Torgesen et al., 1999). In this study, the greatest effect was on passage comprehension. We speculate that this may have been the case because TRI was designed to promote a balanced and comprehensive approach (Fitzgerald, 1999) for individualizing instruction, providing instructional time in both word-level reading skills and text-level reading skills. Specifically, teachers used TRI strategies to teach multiple aspects of reading including phonemic awareness, phonics knowledge, vocabulary, fluency, and comprehension by balancing each session among three major activities—rereading for fluency, word work, and guided oral reading.

The TRI approach appeared to affect all areas of reading, including reading comprehension. Such an effect highlights the interrelationships between word- and text-level reading skills that are part of the daily instructional experience of the individualized TRI setting. Each TRI session provided an opportunity for the classroom teacher to provide direct instruction so that a student flexibly integrated his or her developing word-level skills along with comprehension and text-level skills (Foorman & Moats, 2004). Such exchanges may have provided the optimal environment for the self-teaching theory proposed by Share (1995) in which he contends that students' experiences with phonological recoding, supported by contextual information from the text, allow a developing reader to engage in opportunities to self-teach more about phonological and orthographic properties of new and known words.

We also recognize that comprehension is an extremely complex process, and one that is difficult to measure. Although struggling students who received TRI in the current study significantly outperformed struggling control students in Passage Comprehension, we interpret these findings cautiously. The Passage Comprehension measure as described in the Method section may have measured only certain aspects of comprehension and not others. Thus, the large effect size for Passage Comprehension may also reflect the type of assessment tasks used.

In a preliminary examination of whether teachers might take advantage of the effects of TRI more widely applied rather than just limiting it to instruction for struggling readers, after controlling for initial performance both struggling and nonstruggling children in the experimental schools had significantly higher spring reading scores on all measures except for Spelling of Sounds as compared to all the children in the control schools. However, we also recognize that by aggregating the struggling and nonstruggling students there was a slight decline in the magnitude of effect sizes. Therefore, although we are encouraged by the significant advantage of all sampled students in TRI classrooms over those in control classrooms, we recognize that this effect incorporates the significant advantage of struggling students who received TRI over struggling students in control classrooms from the prior conclusion and interpret this finding cautiously. Nonetheless, there was no evidence that the nonfocal nonstruggling readers were hindered by TRI focus in the schools.

Our study also contributes to the field by showing that TRI can help children who are in high-need, isolated rural areas where children are often poorer and teachers often have less access to traditional professional development. For instance, most interventions have focused on urban/suburban schools or schools that were within driving distance of the host university (Foorman et al., 1998; Scanlon et al., 2008). Thus, findings from the current study suggest that even high-need diverse schools can use classroom teachers to implement successful reading interventions for struggling readers. As was suggested in the introduction, such schools may be an ideal context for intervention because of the other positive contextual factors related to rural schools. For instance, other data suggest that parent support of schools is greater in rural communities compared to more urban schools, and teachers, on average, have more teaching experience (Lee & Burkam, 2002; Provasnik et al., 2007).

Our study is among the first to demonstrate that professional development and literacy coaching can be delivered via webcam technology in schools. To our knowledge, this innovative technology has never been examined as a way to deliver high-level coaching and consultation to isolated schools that are not always able to access professional development due to geographic isolation and fewer resources (Vernon-

Feagans et al., 2009). We recognize that our study did not empirically test the efficacy of webcam technology compared to a different delivery model; however, we hypothesize that the ability to deliver the TRI model via webcam technology may be due to several factors. First, TRI allowed teachers to integrate professional development within their daily teaching (Kelleher, 2003; Taylor et al., 2005), collaborate with other teachers to plan for effective instruction for struggling readers based on student data gathered during TRI instruction (Guskey, 2003; Taylor et al., 2005), and receive support and coaching from an external source, the TRI literacy coach (Taylor et al., 2005). Such a model for teaching and learning may have allowed teachers to carefully create an individualized diagnostic teaching cycle that enhanced struggling students' reading instruction and therefore their achievement, as demonstrated by the medium to large effect sizes. Although we do not yet have quantitative data to suggest whether teachers felt this webcam technology was as good as actual person-to-person consultation, the comments from teachers led us to believe that the live webcam coaching was valuable and easy to use. The platform allowed clear picture and sound for efficient real-time interactions between teachers and TRI literacy coaches. We believe that this technology has great potential for allowing isolated and poorer schools to access the best of professional development at a reasonable cost.

Finally, given the documented interrelationships between students' early vocabulary knowledge and print skills (Hart & Risley, 1995; Neuman & Dickinson, 2002), we were particularly interested in assessing the effects of TRI in light of individual students' vocabulary knowledge. As such, we were interested in whether students' receptive vocabulary was differentially related to students' reading outcome scores. There was no differential impact of TRI on struggling students' reading outcome scores based on beginning-of-the-year receptive vocabulary scores. Findings such as these suggest that TRI may be a useful intervention for many students, and that creating a close match between reading instruction and a student's reading skills may be critical for all children, particularly for struggling readers (Connor et al., 2004, 2007).

Potential Follow-Up Studies and Limitations

Based on the findings from our study, there are several valuable follow-up studies that might be conducted to further investigate TRI. While our study highlights initial support for TRI as a feasible early reading and professional development intervention for rural, low-wealth schools, it is vital to consider studies that can further explore some of the current findings. Examples include examining the contribution of the Guided Oral Reading component to significant results, the efficacy of the webcam delivery of TRI compared with other delivery methods, and whether teachers more widely applied the TRI strategies beyond their struggling readers. Each is briefly discussed below.

It would be beneficial to investigate whether the Guided Oral Reading component of the TRI contributed to the significant results. We speculate that within the TRI Guided Oral Reading task, students encounter new words, new ideas, and new stories, and such a context might provide a challenging environment for children to integrate and simultaneously develop both word- and text-level skills. Previous early interventions may not have given as much instructional time to text but instead have spent the majority of instructional time on individual letters/sounds, later moving to

decoding words in isolation, and finally connected texts (e.g., Oakland, Black, Stanford, Nussbaum, & Balise, 1998). When whole texts were finally used in many of these interventions, they were often highly decodable texts that were not always matched to individual children's reading needs; instead they were drawn from a scope and sequence of phonics elements (e.g., Gillingham & Stillman, 1997; Osborn, 1995).

A second valuable study might investigate the efficacy of the webcam technology compared with face-to-face coaching and consultation. Unlike other studies, we were able to demonstrate the efficacy of TRI while it was delivered via webcam technology in schools. For rural schools that are not always able to access professional development because of geographic isolation and fewer resources (Vernon-Feagans et al., 2009), it would be useful to learn about the efficacy of the webcam delivery. Results from such a study would, in part, be useful in determining the best ways to provide professional development and early reading intervention for isolated rural schools.

Third, it would be valuable to examine whether teachers more widely applied the TRI strategies beyond their struggling readers. We speculate that it is possible for teachers to more widely apply the professional development and TRI instructional strategies with nonstruggling students as well as struggling students. Through such application, teachers might enhance their classroom reading instruction and provide more effective early reading instruction (Pressley et al., 2001; Taylor, Pearson, Clark, & Walpole, 2000) for all students, thereby leading to enhanced learning outcomes for students. If enhanced reading instruction were the case, it would suggest that the time teachers use to individualize instruction for the students most in need in the classroom does not detract from the learning of the other students in the classroom.

While our study highlights preliminary support for TRI as a viable early reading and professional development intervention for rural, low-wealth schools, it is vital to consider limitations of the current study. First, our study evaluates TRI compared to a "business as usual" control; however, it would be important to evaluate the efficacy of TRI against other early reading interventions, which could provide further support for the efficacy of TRI. Second, results from the current study do not explain which specific elements of TRI instruction were related to students' gains. Additional studies involving treated controls could provide evidence about which aspects of TRI are most influential. Third, the current study evaluates the effects of TRI over the course of one school year. It is vital to evaluate the long-term effects of the TRI. Other early reading interventions, such as Reading Recovery (Clay, 1993), have shown declining effect sizes over time for students who received the intervention (Wasik & Slavin, 1993). Studies evaluating the long-term effect of TRI would be extremely valuable and could add to the research base on early reading intervention.

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