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Helping Urban Teachers Help Students Read Science: A Partnership

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Abstract

Eighty percent of fourth graders in a Northeast school had not met the NCLB reading "goal." Research questions asked: Will comprehension strategies move students toward proficiency, and will a researcher-teachers collaboration support that effort? Data included student artifacts, student interviews, discussion transcripts, researcher lesson plans, and field notes. Data were analyzed through coding and constant comparison. Surveys confirmed that students learned comprehension strategies; student writing confirmed that they learned content. However, only 38% reached "proficiency" on standardized tests. Comprehension strategies were necessary but not sufficient for reading. Guided reading increased intensive instructional time but reduced time for learning content.

Key Words: reading comprehension strategies instruction, reading of science texts, urban education, researcher-teachers collaboration

Helping Urban Teachers Help Students Read Science: A Partnership

In collaboration with the 5 fourth grade teachers of Striving Elementary School (a pseudonym), the researcher acted as a participant observer to provide and study the scaffolding students need to read science texts. The study focused on the support provided by student learning of reading comprehension strategies, particularly, visualizing, making inferences, monitoring comprehension, and synthesizing, as well as determining importance, questioning the text, and making connections (Keene & Zimmerman, 2007; Lanning, 2009; National Reading Panel, 2000; Pressley, 2007). Since teachers know their students better than a visiting researcher does, teachers act as knowledgeable insiders (Spradley, 1979) in establishing a research agenda that will apply to their own classrooms. Researcher-teacher collaborations have conducted several successful studies. For example, Baumann and Ivey (1997) worked as participant observer and second grade teacher to explore the effects of combining responsive teaching with specific skills/strategies teaching. McCutcheon and Berninger (1999) and teachers established a "collaborative clinical partnership" (p. 224) whereby teachers, with the researchers' help, applied research theories to their literacy practice, thus increasing their expertise which they shared with other teachers through in-school institutes. Significantly for this study, Crossley and Holmes (2001), in an exploration of shifting research paradigms, described "participatory research" as one that shifts the role of the researcher from "expert" to "collaborator" (p. 398).

Purpose

The study sought circumstances that improved students' enthusiasm for and expertise in reading science texts (Guthrie & Wigfield, 2000). A researcher-teachers partnership sought "to understand, interpret, and explain complex and highly contextualized social phenomena" (Kamberelis & Dimitriadis, 2005, p. 17), such as the circumstances under which students learned comprehension strategies and applied them successfully to reading science texts (Thier and Daviss, 2002). The study sought to answer the following questions about the population studied:

1) In what ways does a researcher-teachers collaboration contribute to movement toward grade level in reading (Connecticut Department of Education, 2010)?

2) In what ways does the discussing of science texts in small groups enhance understanding of abstract scientific phenomena (Honig, 2010)?

3) In what ways do learning and applying of reading comprehension strategies contribute to reading proficiency (Keene & Zimmerman, 2007; Lanning, 2009; National Reading Panel, 2000; Pressley, 2000)?

Theoretical framework

Vygotsky's (1962) theory that a student makes progress when supported in his or her "zone of proximal development" (p. 104) provided the framework for this study. Vygotsky's insights have been incorporated into the "Gradual Release of Responsibility" teaching structure that supports students through teachers first modeling and explaining comprehension strategies, next working with the whole class to explore and provide additional models, and finally releasing responsibility to small groups and individuals for applying the strategies (Brown, 2008; Keene and Zimmerman, 2007; Lanning, 2009; Pearson & Gallagher, 1983). In an iteration of the guided release of responsibility teaching frame, Fisher and Frey (2007) offered an urban school scaffold that included "direct instruction or modeling," "guided instruction," "collaborative learning," and "independent practice" (p. 36). The National Reading Panel (2000) insisted on the importance of teaching the reading comprehension strategies that proficient readers use. Calkins (2001), as well as Pressley, Mohan, Raphael, & Fingeret (2007), described the support for comprehension inherent in such reading strategies as self-questioning, self-monitoring of comprehension, visualizing, inferring, and synthesizing, while Guthrie & Wigfield (2000) discovered the importance of providing interesting science content through trade books that students chose to read. Cazden (2001) and Daniels (2002) determined that discussion is important in supporting concept development. These were the research-based theories that contributed to the scaffolding the researcher and teachers provided for students.

Methodology

For a fourth school year the researcher acted as a participant observer (Spradley, 1979) in the 5 fourth grade classrooms of a 77.8% poverty, 70.5 % minority school in a Northeast city (Connecticut Department of Education, 2010). The researcher was invited into the district by the language arts supervisor, a former state literacy consultant and colleague of the researcher when the researcher was a district reading coordinator. The language arts supervisor selected a school that received few resources, in comparison to district magnet schools, in the hopes that the researcher would serve as a source of professional development as she modeled the teaching of reading comprehension strategies (Reed, 2009) and asked questions that would bring about teachers' reflection on their practice (Friere, 2000). The school principal selected a grade level with strong, motivated teachers.

The researcher embraced Pressley's (2000, 2001) theoretical point of view and shared it with teachers: While multiple factors influence students' reading proficiency, one of the most important is students' learning and application of comprehension strategies. Brown, Pressley, Van Meter, and Schuder's (1996) description of "transactional strategies instruction," (p. 19), where the teacher models, explains, coaches, and emphasizes the value of a few powerful reading comprehension strategies and where classroom discussion focuses on the use of those strategies, informed the researcher's perspective (Alverman, et al., 1996). By "transactional" Brown, et al. (1996) meant that the group "co-determines each other's thinking about text," (p. 19), constructs meaning together, and connects text to prior knowledge (Rosenblatt, 1978). Through these processes, the researcher and teachers helped students construct meaning of science texts.

Data included transcripts of student discussions and interviews, student artifacts such as notes written while reading and essays and poems written afterwards, researcher lesson plans and teaching artifacts, and field notes reflecting on conversations with teachers. The researcher generated theory from that data (Glaser & Strauss, 1967) through a "constant comparative method" of analysis (Glaser & Strauss, 1967, p 104) comprised of coding incidents into categories and examining a resulting insight for "conditions under which it is pronounced or minimized" (Glaser & Strauss, 1967, p. 106). NVivo 8 software (http://download.qsrinternational.com/Document/NVivo8/NVivo8-Introducing-NVivo.htm) lent support in coding such categories as "comprehension strategies applied," "science content learned," "writing skills demonstrated," "guided release procedures incorporated," "lunchtime ideas shared," "effective student discussions held," "student motivation observed," and "researcher-teachers collaboration implemented." The researcher strove for "saturation" of categories, or collecting data until all that could be learned about a particular theme seemed to have been learned (Glaser & Strauss, 1967, p. 111). To triangulate data, the researcher first discussed implications with teachers when data seemed to converge on a theme, such as "comprehension strategies applied," then wrote a "thick description" (Geertz, 1973, p. 6) to draw conclusions "from small, but very densely textured facts" (Geertz, 1973, p. 28), confirming with teachers that the conclusions drawn were ones with which the teachers agreed.

The author grounded the research in the "predominant ideas" of the field while paying attention to "hunches" (Alvermann, O'Brien, and Dillon, 1996, p. 115) to build a grounded theory, with the help of the teachers, about the processes that moved struggling fourth graders toward proficiency in reading. That is, the researcher examined the data in light of such theories as effective research partnerships (KFPE, 1998), as well as effective teaching of reading comprehension strategies (Pressley, 2000, 2001), then shared insights for confirmation with the teachers. As with all qualitative research, writing about themes (Agar, 1980) as well as writing drafts of this paper (Kamberlis & Dimitriadis, 2005) formed inchoate ideas into a grounded theory (Glaser & Strauss, 1967). Finally, the researcher sifted and sorted data to select examples of findings to include (Alvermann, O'Brien, & Dillon, 1996).

Results

Results will be discussed in terms of the three research questions that focused this study:

Research question 1. In what ways does a researcher-teachers collaboration contribute to movement toward grade level in reading (Connecticut Department of Education, 2010)?

Researcher-teachers collaboration provided support for students' reading achievement in multiple ways, best seen through the following principles of effective research partnerships offered by the Swiss Commission for Research Partnerships with Developing Countries (KFPE, 1998) and endorsed by Crossley and Holmes (2001, p. 401). These supports not only contributed to students' progress toward reading proficiency but added to teachers' professional development and the researcher's better understanding of students and school conditions, as described below:

Decide on the objectives together. Teachers welcomed the researcher into their classrooms to help students become proficient readers of science texts, an objective decided upon collaboratively with the teachers, principal, and language arts supervisor because the district used a core reading program that teachers were asked to teach with fidelity (Duncan-Owens, 2009) and that did not provide for a researcher to teach and study student's learning of reading comprehension strategies. Therefore, teachers and researcher focused on the goal of reading science texts proficiently. Focusing on curriculum themes through trade books and Internet articles provided support and motivation for students' reading (Guthrie & Wigfield, 2000). However, the overarching goal for the teachers was to help their students succeed on standardized tests. Therefore, the researcher and teachers taught students to use graphic organizers to remember information (Calkins, Montgomery, & Santman, with Falk, 1998, p. 54), made certain students had "opportunities to talk about and make sense of what they read" (p. 50), and confirmed that the state test "values the same things that we value in our classrooms" (p. 170).

Build up mutual trust. Over the course of a four year partnership between the researcher and teachers, mutual trust developed as the teachers opened every aspect of their classroom teaching to the researcher's questions and the researcher treated their conversations with confidentiality. Thus the researcher was able to serve as an extra adult in the room trusted by teachers to provide reading help, in this way helping the teachers support students' reading (Fountas & Pinnell, 2001; Howard, 2009).

Share information; develop networks. The teachers provided information about students and assessments, while the researcher shared information about reading research and the newly adopted Common Core State Standards (The Council of Chief State School Officers and the National Governors Association Center for Best Practices, 2010). Networks developed as teachers spoke in the researcher's graduate education classes about the teaching of reading and writing and opened their classrooms for the researcher's teacher candidates to conduct practice assessments of fourth grade students. The researcher, in turn, shared information about her university's courses, programs, and student teaching practices when teachers inquired. Teachers arranged their day so the researcher could be in each of their classrooms. Thus the researcher became more knowledgeable about students' needs and teachers more knowledgeable about reading research and standards, both more able as a result to support students' reading progress (McCutcheon and Berninger, 1999).

Share responsibility. The researcher-teachers partnership incorporated a variety of shared-responsibility features. The teachers determined the order of science topics to be taught within the district's fourth grade science curriculum. To supplement limited classroom science texts and Internet texts above students' reading levels, the teachers approved of the researcher's purchase of a classroom subscription to *National Geographic for Kids* with a university grant provided for purchase of texts at students' reading levels. In three classrooms the researcher taught the whole class with the teachers' collaboration. That partnership included the researcher and teachers modeling comprehension strategies and working with small groups to guide students in applying the modeled strategies (Lanning, 2009). In two classrooms the researcher worked with two small groups each week for thirty minutes each on teacher-selected science topics as the classroom teacher, ESL or special education teacher, and classroom aide worked with other small groups, and a final group or two worked alone. The teachers-researcher partnership shared responsibility for student achievement, and the school/university collaboration was noted on the school's Strategic Profile (Connecticut Department of Education, 2010). Thus a convergence of knowledgeable adults discussed and offered solutions to the problems students' needs presented (Calkins, 2001). The researcher and teachers were particularly cognizant that we were all White, middle class, and native speakers, while the students represented cultures of which we were not members (Love & Kruger, 2005), among them Hispanic, Albanian, and African American (Connecticut Department of Education, 2010). We were committed to treating students in equitable, caring ways that did not contribute to "racially marginalized students" whose feelings of inadequacy could lead to poor performance or whose beliefs in the power of education could be devalued (Lynn & Parker, 2006, p. 283). We knew that standardized tests could not measure urban student achievement as well as could book discussions that showed that students were applying their reading comprehension strategies to science texts (Scott & Teale, p. 341). Nevertheless, standardized tests loomed large (Calkins, et al., 1998).

Create transparency. The researcher and teachers created transparency through a sharing of the researcher's conference papers and journal articles (Queenan, 2007, 2008, 2009, 2010) with teachers' advice, corrections, and feedback incorporated into the articles or presentations before submission or presentation. Thus teachers and researcher stepped back from students' day to day needs to find broader patterns linked to published research that offered solutions for problems and direction for teaching and learning. This reflection on practice, or what Freire calls "praxis, the action and reflection of men [*sic*] upon their world in order to transform it" (p. 66), helped the teachers and researcher provide research-based support for student learning (Lanning, 2009).

Monitor and evaluate the collaboration. At an end of the year luncheon celebration, the teachers and researcher evaluated the year's teachers-researcher collaboration while at weekly lunchtime conversations, the partners monitored the progress of the project and shared insights into the reasons for students' growth. Thus through monitoring and evaluating of the researcher-teachers collaboration, suggestions of ways to support students' learning were developed and implemented in an ongoing way (Reeves, 2004). For example, the researcher and teachers discovered that some prompts were more valuable in generating discussion than others (Blum, Koskinen, Bhartiya, & Hluboky, 2010). In particular, we discovered that students enjoyed sharing what they had visualized and inferred and, to our surprise, what they did when they were "stuck": Most reread, but some visualized, some read on hoping to become unconfused, and a few enterprising students asked their peers, parents, and older siblings to help them understand.

Disseminate the results. Results have been disseminated through presentations (Queenan, 2007, 2008, 2009, 2010) and publications (Queenan, 2008, 2009). To write papers for conferences and publication, the researcher examined data to illuminate patterns in students' learning, thereby making teachers and researcher more aware of students' needs and better able to support the goal of students' learning science concepts with the support of reading comprehension strategies (Guthrie, Van Meter, Hancock, Alao, Anderson, & McCann, 1998; Pressley, Mohan, Raphael, & Fingeret, 2007).

Apply the results. Findings were applied as the researcher eschewed colorful think sheets in favor of two column notes and student-drawn concept maps because we found that they encouraged greater student focus on science concepts. Teachers taught comprehension strategies vigorously because the researcher's once-a-week lessons were not frequent enough to ensure student learning. The researcher also put aside Internet articles beyond students' reading levels, even though they were sometimes the only resource on a topic. The teaching of comprehension strategies, the insistence on appropriate level texts, and the implementation of just-right note taking supported students' reading growth (Allington, 2007; Keene & Zimmermann, 2007).

Share profits equitably. There have been no profits, and none are anticipated. However, the researcher requested and received a modest grant from the university for the purchase of student science trade books, student magazines with a science focus, and professional texts on the teaching of comprehension (Howard, 2009; Johnson, 2006; Lanning, 2009). Discussing professional literature increased teachers' knowledge of reading comprehension instruction and thereby supported students' reading growth, as did students having science texts they could read (Allington, 2001). Vygotsky (1962) discovered that students are best supported when they are taught at a just-right level. Teachers determined that level by administering the Developmental Reading Assessment II (Beaver & Carter, 2006), and the researcher strove to supply science-based curriculum texts at students' reading levels.

Increase research capacity. With teachers' support, parents accepted the researcher's presence in the classroom and signed research consent forms for students to be interviewed and their artifacts incorporated into the study, increasing research capacity by expanding access to data. Teachers' expertise in the teaching of comprehension strategies increased through researcher–teachers' conversations about professional texts. Principles described in the professional literature were incorporated into lunchtime conversations about school data teams (Reeves, 2004); students' progress (Beaver & Carter, 2006); and curriculum assessments where students synthesized their learning in letters to next year's fourth graders (Calkins, 1994), Readers Theater Plays (Raskinski, 2010), and poems about science topics (Kucan, 2007). Increased teacher expertise and assessments examined for unmet students' needs not only provided additional support for students' reading growth (Reeves, 2004) but additional teacher insight into answers to the project's research questions.

Build on the achievements. Earlier findings (Queenan, 2007) illuminated an increase in student engagement when teachers took part in small group discussions. This finding encouraged teachers to continue their devotion to co-constructing meaning with small groups. Teachers' and the researcher's modeling of their thinking helped students develop the capacity to understand and use the abstract language of science. Teachers incorporated small group work into their lessons to build on students' ability to use "receptive" and "expressive" science discourse language (Honig, 2010) as they read, wrote notes, and synthesized their learning.

Research question 2. In what ways does discussing science texts in small groups enhance understanding of abstract scientific phenomena (Honig, 2010)?

In order to establish clear criteria for discussion (Bruss, 2009) and create productive discussions where students developed science topics, spoke in soft but audible voices, and increased their understanding by listening to each other and asking questions, the researcher and teachers asked students to observe “Fishbowl discussions” (http://www.nwlink.com/~donclark/hrd/learning/fishbowls.html) in which the researcher, teacher, and a few articulate students took part. Students then offered advice for ensuring “a good conversation.” Miss White’s students (All teacher and student names are pseudonyms) created the following set of rules for holding a good discussion:

Discussion Rules:

- Listen to people.
- Talk quietly, but make sure people can hear you.
- Don’t interrupt.
- Participate/share ideas.
- Ask questions.

After participating in several such discussions about electricity in Miss White’s class, Melissa helped to create a concept map or visual depiction of the information in the text, wrote important information about electrical currents on the left side of her paper, and said why she considered the information important on the right side. In this way she showed her ability to use the expressive or written language of science (Honig, 2010). When she finished writing, Melissa discussed her ideas with her group to clarify them and created the following

"If I were" poem following the format of other "If I were" poems like Judith Viorst's "If I Were in Charge of the World" (http://www.poemhunter.com/poem/if-i-were-in-charge-of-the-world/).

If I were an electron, I would have a negative electric charge.

If I were an electron, I would always move with my negative charge.

If I were an electron, I wouldn't like glass or air or plastic.

If I were an electron, I would move along a path called a circuit.

If I were an electron, while I move through conductors the circuit is complete.

If the circuit is removed, then I'll stop.

(Students' misspellings have been corrected):

After following the same learning process, Melissa's classmate Klement demonstrated the capacity to use the expressive language of science in a letter synthesizing pages of notes:

Dear Fourth Grade Student,

You will learn so much about electricity and other stuff. I would like to tell you some of them like mechanical energy, chemical energy, series circuits, parallel circuits, electronics, temporary magnets, electric current, static electricity, and how electricity was discovered and inventions that include electricity and that electrons have negative energy and that a nail can become a temporary magnet. Electricity can go through you if your hands are wet. Electricity tries to find the shortest way to the ground. Electricity is very dangerous. Don't *go near it or touch it when you are wet. Magnets attract steel and iron and they have two sides called N and S, and if you rub something to a magnet, it will become a temporary magnet….*

Karen, too, demonstrated the ability to use expressive language about science concepts in her letter: *…Parallel circuits have more than one path so if one breaks, electricity will go through.* Quite apparently, students learned to read or use the receptive language of science, then use the expressive or written language of science to communicate important concepts (Honig, 2010). Unfortunately, a few students wrote advice on how to behave in fourth grade or turned in blank papers. These students did not demonstrate an understanding of scientific concepts.

Research question 3. In what ways do learning and applying reading comprehension strategies contribute to reading proficiency (Keene & Zimmerman, 2007; Lanning, 2009; National Reading Panel, 2000; Pressley, 2000)?

Teachers, in this fourth year of researcher-teachers' collaboration, began teaching comprehension strategies even before the researcher received permission from her institutional review board to begin. On October 27, the researcher's first day in the classrooms, students contributed to anchor charts (Harvey & Goudvis, 2008) of examples of the ways they used comprehension strategies with fiction texts. Students in Mr. Silver's class offered:

- <u>Asking questions (wondering)</u>: *Before I go to the next page I ask a question about what happened.* (Note: The researcher combined two sets of comprehension strategies posted on classroom walls, one set reflecting the comprehension strategies descriptors used in the field [e. g. National Reading Panel, 2000; Pressley, 2000]; one set, suggested by the district [Boyles, 2004], represented by the descriptors in parentheses in this example).

- Visualizing (picturing): *I imagine I am in the story. I think of the stuff in the story in my head. I make an image in my head. I draw it down.*
- Inferring (figuring out): *I look at the problem to figure out what's happening/how to solve the problem. I try to figure out what's going to happen.*
- Determining Importance (noticing): *I ask myself questions about what's happening. I look for important clues. I reread. I reread until I get it. I read the sentence and get the picture.*
- Connecting (putting it all rogether): *I find the important details of the main idea. I connect it to another book or my life.*
- Monitoring comprehension: *I find out what is happening. I look at pictures, the title at the top, "What it's about." I ask questions. I ask the teacher.*

While several students offered the above examples at the beginning of the research project, most students in completing a researcher-created "Comprehension Strategies I'm Comfortable Using" questionnaire on the same day showed that they did not know the strategies. For example, Millie and Ibrahim answered "I don't know" after each strategy; Walter and Wimmet copied the descriptors in parentheses as their answers; others combined blank spaces, "I don't know," and plausible descriptions such as Kandy's, "I picture what is going on in the story." By June 7, however, students had made progress in understanding most comprehension strategies as shown by Mr. Silver's 21 responders, Miss White's 18, and Mr. Blue's 16 to the same researcher-created questionnaire:

Response in June to Questionnaire on Comprehension Strategies Usually Applied

	Mr. Silver	Miss White	Mr. Blue
# of Students	21	18	16
Connecting	0	11	12
Determining Importance	12	4	4
Inferring	11	9	6
Monitoring comprehension	17	15	2
Questioning	13	5	10
Synthesizing	14	10	0
Visualizing	13	17	12

Even though students professed comfort in using comprehension strategies, only 38% progressed to grade level on the state standardized assessment (Connecticut Department of Education, 2010). Nevertheless, all but four students moved up in reading levels, according to the Developmental Reading Assessment II (Beaver & Carter, 2006). In Mr. Silver's class, 13 students moved up one level, 5 students moved up two levels, 3 students moved up three levels, while 4 students didn't move up a level. In Miss White's class, 5 students moved up one level, 9 students moved up two levels, 3 students moved up three levels, and 1 student moved up four levels. In Mr. Brown's class, 6 students moved up one level, 10 students moved up two levels, 4 students moved up three levels, 2 students moved up four levels, and 1 student moved up five levels. In Mr. Greene's class 5 students moved up one level, 5 students moved up two levels, 5 students moved up three levels, 2 students moved up four levels, and 4 students moved up five levels.

Students' growth in reading levels, according to the Developmental Reading Assessment

Teacher	0 levels	1 level	2 levels	3 levels	4 levels	5 levels
Mr. Silver	4 students	13 students	5 students	3 students	n/a	n/a
Miss White	n/a	5 students	9 students	3 students	1 student	n/a
Mr. Brown	n/a	6 students	10 students	4 students	2 students	1 student
Mr. Greene	n/a	5 students	5 students	5 students	2 students	4 students

Students might have made progress because their teachers created a community in their classrooms, sought parental involvement, and provided direct instruction, repetition, and practice (Love and Kruger, 2005). When the researcher asked Mr. Greene why students progressed, he responded that students who are motivated will learn and parental involvement dictates success.

He also said that he now taught reading comprehension strategies knowledgeably in contrast to four years ago when the strategies were “just words.”

Conclusions

In the researcher’s fourth year of collaborating with the fourth grade teachers in this urban school, new partnerships emerged: parallel teaching in Mr. Greene’s and Mr. Blue’s classrooms as the researcher, teacher, and other professionals worked in guided reading groups and co-teaching in Miss White’s, Mr. Silver’s, and Mr. Brown’s classrooms as the researcher and classroom teacher worked side by side to model comprehension strategies and hover over small groups as students discussed science articles and applied comprehension strategies. While both forms of teaching and collaborating were comfortable for adults, time with adults was reduced for students in the guided reading classrooms, although that time provided more intensive adult-student interaction. Students in the guided reading groups were not exposed to the same amount of text by the researcher and did not learn the same amount of content. As a result, when it came time for students in the researcher’s guided reading groups to synthesize information to write letters to next years’ fourth graders, they did not have enough information to synthesize. Therefore, when guided reading is suggested as an intervention for struggling readers (Fountas & Pinnell, 2001; Howard, 2009), teachers must balance the amount of content students will miss with the amount of intensive instruction they will receive; for instructional practices, as Scott and Teale point out are “where the rubber meets the road” (2010, p. 339) in eliminating the achievement gap.

Fourth grade urban students learned and independently applied the reading comprehension strategies of visualizing, inferring, monitoring comprehension, and determining importance while reading. They synthesized with teacher support. What students could not do was read grade level content texts, first because few texts were available and most Internet articles were above students' reading levels but especially because these fourth grade students did not have the background to think abstractly about electrical circuits, force and motion, and biomes. Teachers preceded the study of science content with having students contribute to K-W-L charts; however, few students were able to contribute great understanding to previously unstudied science concepts. Therefore, when determining the focus for resources, schools and districts have an obligation to find and provide science curriculum texts at students' reading levels, especially when those reading levels are below grade level. Students will be unable to learn science concepts otherwise. In addition, district and state curriculum writers should consider students' probable background knowledge when selecting curriculum topics district- and state-wide.

Students should also be taught Question Answer Relationships (QAR), including advice on how to answer questions whose answers are explicit in the text, those that require the making of inferences, and those that require the student to engage his or her schema (Raphael, Highfield, & Au, 2006). Kinnenburg and Shaw (2009) provide questions about the topic of storms to illustrate that QAR is well used in science. For example, an "on my own" question might be: "Have you ever been in an airplane during bad weather? Do you think there might have been a downdraft?" A "right there" question might be: "What is lightning?" A "think and search" question might be: "What should you do if a tornado is coming?"; and an "author and me" question might be: “If you hear thunder and 10 seconds later you see the lightning, how many miles away is the lightning strike? (Appendix A, p. 24). Perhaps with the use of a framework like QAR, which enables students to engage their background knowledge to answer the kinds of questions that are asked on the state mastery test (Connecticut Department of Education), teachers will not have to spend the months between September and March on test preparation.

Educational Implications

While whole group instruction followed by small group practice as the teacher confers with individuals or groups of students is traditional (Calkins, 2001), guided reading, or small group reading work with the teacher’s close guidance, is increasingly popular as an intervention for students not reading at proficient levels (Fountas & Pinnell, 2001; Howard, 2009). A study such as this one that contrasts the breadth of students’ learning in a whole group setting with the depth of teacher attention in a guided reading setting highlights the benefits and challenges of each. Implications of this study suggest that guided reading increases intensive instructional time with teachers but reduces time for learning content. For example, Mr. Greene’s classroom schedule of three guided reading groups and two independent centers in three daily 30 minute rotations provided for students to meet with him in guided reading groups three times a week for 30 minutes each time, work independently five times, work with the aide three times, and work with the special needs teacher three times. In contrast, teachers using the Guided Release of Responsibility Model (Brown, 2008; Keene and Zimmerman, 2007; Lanning, 2009; Pearson & Gallagher, 1983) use the same 90 minutes daily to teach whole group minilessons and provide whole group practice before circulating among small groups and individuals as students apply the lesson to their reading. Teachers then bring the class back together for a closing summary of the lesson. The differences between the two frameworks include daily whole group minilessons, daily guided practice, and daily lesson summaries in the latter model versus intensive teacher attention three days a week in the former. Since Mr. Greene's students outperformed other students in the Developmental Reading Assessment II (Beaver and Carter, 2006), it might be concluded that intensive small group guided reading instruction three times a week is more fruitful than whole class instruction followed by guided small group and individual application daily. However, that is an implication that requires further study.

The National Reading Panel (2000) insisted that comprehension strategies be taught. The researcher-teachers partnership in this study taught those strategies, but the achievement gap remained (Vanneman, A., Hamilton, L., Baldwin Anderson, J., and Rahman, T., 2009). A study that examined urban students' successes and challenges with learning science content as they applied comprehension strategies to that content should illuminate some of the challenges of eliminating that gap. This study suggests that comprehension strategies, while necessary, are not sufficient for student comprehension of science texts. While students moved up levels on the Developmental Reading Assessment II (Beaver & Carter, 2006), only 38 percent reached proficiency on the state standardized test (Connecticut Department of Education).

Their and Daviss (2002) noted that combining science and literacy develops "reciprocal skills" in both subjects (p. 6). Among the skills the authors pointed to are several that this study observed: Students were curious about science content; science concepts were well expressed through writing; comprehension skills were taught through science; and writing provided tools to assess students' understanding of science concepts. The fourth grade teachers of Striving Elementary School have discussed moving away from their core reading program in order to teach literacy through science trade books. If the teachers are given adequate professional development and the students are provided with just-right trade books and hands-on science experiences, an exponential growth in reading might occur (Guthrie & Wigfield, 2000).

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