Marshall Memo 139

A Weekly Round-up of Important Ideas and Research in K-12 Education

June 5, 2006

In This Issue:

Quotes of the Week

"Intellectually honest liberals and conservatives have absolutely nothing to fear from the truth."

Arnold Burron in "Controversial Issues: They Belong in the Classroom," April 2006 Education Policy Center *Issue Backgrounder*

"Well-designed instructional materials, such as textbooks, teachers' manuals and software, may provide significant mathematical support, but cannot substitute for highly qualified, knowledgeable teachers."

Deborah Ball et al. (see item #2)

"You cannot teach for understanding unless you understand the mathematics you're teaching."

Randal Charles (see item #3)

"Students who do not have a deep understanding of mathematics suspect that it is just a jumble of unrelated procedures."

California Mathematics Curriculum Framework, 1999

"People aren't aware of how hard a teacher physically has to work, not only to manage but to actually teach 150 students a day. As in any activity, the natural tendency is to want to conserve energy. It's easier and faster to let the student who knows the answer respond to you."

Paige Allison, Florida high-school math teacher (see item #6)

"If administrators want teacher meetings to focus on instructional improvement, they must provide guidance about how to do this and follow up to ensure that meeting time is used productively."

Janet Quint (see item #5)

1. What's the Scoop on Foreign Language Teaching?

This helpful summary in *Research Points* addresses three commonly-asked questions about foreign language instruction in schools:

• *What's the best age for children to start learning a foreign language?* Young children quickly absorb any language they are surrounded by and learn to speak a new language more quickly than adults. But their advantage is less decisive than it seems. Compared to older learners, primary-age students do best with pronunciation, are somewhat weaker in learning grammar, and are about the same in picking up vocabulary. While early-starters are more likely to end up speaking like a native, adolescents and adults actually learn foreign languages faster. To become proficient in all aspects of a foreign language, students need explicit instruction and practice in grammar and vocabulary, and this happens best in the upper grades. "[S]ome child learners end up with accents and incomplete second language grammars," say the authors, "and some adult learners become, for all practical purposes, as skilled as native speakers."

Starting early with foreign language instruction makes sense only if students are in an immersion program and have teachers who know the language well. "A few hours a week of foreign language instruction focusing on learning words, songs, and a few ritualized exchanges," write the authors, "is good for cultural exposure and appreciation, but do not expect real mastery."

• *What teaching methods work best?* The best immersion programs for younger students integrate the second language with instruction in all subjects and focus on attaining the skills needed to communicate about and understand academic subject matter, not on mastering a foreign language for its own sake. These programs give students plenty of chances to use the new language in real conversations with other students and adults, and expose students to a variety of native speakers. Some parents worry that an immersion program will impair their children's proficiency in English, but studies have shown that, while there may be an initial lag in English achievement, full-immersion students catch up and score at least as well as monolingual students in verbal and math skills – and may do better in some areas of cognitive processing.

But immersion is not the only way to learn a new language. "For older students," write the authors, "effective foreign language instruction includes direct teaching, systematic practice involving rules and grammar, and plenty of opportunities for conversation. It should be aimed at having students express and understand fully formed ideas and phrases, as well as learn the language's structure." Balance is vital, according to the research: not too much emphasis on meaning, but not too much mechanical drill.

• *Can anyone become proficient in a foreign language?* Differences in individual aptitude definitely affect how quickly and well a person learns a new language. Specialized tests can measure a person's sensitivity to sound (this affects pronunciation in the new language), sensitivity to structure (this affects grammar), and memory (this affects vocabulary). A language learner's aptitude is also affected by age, the way the person is exposed to the language, and the "linguistic distance" of the language being learned from English. This is how many hours of classroom instruction it takes the average person to learn each set of languages:

- Close to English (e.g., Dutch, French, Spanish) – 600 hours
- Different from English (e.g., Farsi, Russian, Urdu) – 1,300 hours
- Far from English (e.g., Arabic, Chinese, Japanese) – 2,200 hours

In addition, language learning can be accelerated and improved when motivation is high, for example, if a person needs to learn a language to get a job, travel, or integrate into a community.

The article concludes with four summary points:

• Starting early does not guarantee that a language will be learned.

• Age-appropriate instruction is key: total immersion works best for young children (if the school is willing to make the commitment and has expert staff); a more explicit approach to structure and vocabulary works best for adolescents and adults.

• Be realistic with students and parents about how much proficiency can be developed in a few hours a week, especially in preschools and elementary school. While such limited exposure won't lead to mastery, it may build motivation and a "taste" for language learning later on.

• "Recognize that for almost everyone, high proficiency in a foreign language will develop outside the classroom, through conversation with native speakers made possible by the skills acquired in the classroom."

"Foreign Language Instruction: Implementing the Best Teaching Methods" by Chris Zurawsky and Robert Dekeyser in *Research Points*, Spring 2006 (Vol. 4, #1, p. 1-4).

2. Finding Common Ground in the Math Wars

In this encouraging article, *Science* editor Jeffrey Mervis reports on the progress that's been made to end the maddening "math wars" between some educators and professional mathematicians and cut down the onerous number of math standards at each grade level.

The argument between "direct instruction" and "discovery learning" has dragged on for years, with protagonists in each ideological camp lobbing verbal grenades at each other. This has made it difficult to set helpful state standards and improve the dismal state of math achievement in most American schools.

Two years ago, mathematician Richard Schaar launched the Common Ground initiative and brought together "top guns" from both sides to see if they could come up with areas of agreement. After six meetings, the group released a brief document designed to guide math teaching from kindergarten through high school ("Reaching for Common Ground in K-12

Mathematics Education" by Deborah Loewenberg Ball, Joan Ferrini-Mundy, Jeremy Kilpatrick, James Milgram, Wilfried Schmid, and Richard Schaar; the full article is available at http://www.maa.org/common-ground/cg-report2005.html). Their paper deals with the "what" of curriculum, not the "how to," and rests on three basic principles:

• *Students need to be proficient with numbers* – Basic computational skills are vital for everyday life, the workplace, and higher-level math. By proficiency the authors mean both computational fluency and understanding of the underlying mathematical ideas and principles.

• *Students need to be able to reason precisely* – "Mathematics is communicated by means of a powerful language whose vocabulary must be learned," say the authors. By precise, they mean careful use of math terms and symbols in a way that is appropriate to each grade level. "We do *not* mean formality for formality's sake," they are quick to add.

• *Students must be able to solve problems* – Doing this right involves the following steps: clearly understanding the problem; translating the problem from everyday language into a precise mathematical question; choosing the best way to answer the question; checking back to the original problem to see if the solution makes sense; and knowing that not all questions can be solved mathematically.

The report's authors developed these basic principles into the following areas of common agreement:

a. Automatic recall of basic facts – "Certain procedures and algorithms in mathematics are so basic and have such wide application that they should be practiced to the point of automaticity," write the authors. "Crucial ingredients of computational fluency are efficiency and accuracy."

b. Judicious use of calculators – Calculators are important starting in the lower grades, they say, but calculator use shouldn't interfere with students becoming fluent with basic facts and computational procedures. Too much use of calculators can also interfere with students' understanding of fractions, and graphing calculators used too early can prevent students from understanding graphs.

c. Learning algorithms – Students should be fluent in the basic algorithms of whole numbers from 0 to 10. As they're committing them to memory, students should also learn how and why the algorithms work. "These basic algorithms were a major intellectual accomplishment," write the authors. "Because they embody the structure of the base-ten number system, studying them can reinforce students' understanding of the place value system." Of course there are other algorithms to learn as students move through the grades, including constructing the bisector of an angle, solving two linear equations in two unknowns, and calculating the square root of a number by a succession of dividing and averaging.

d. Understanding fractions – Without a solid foundation in fractions, it's much more difficult for students to understand ratios, proportions, percentages, and algebra.

e. Appropriate use of real-world contexts – Grounding math concepts in everyday situations can help students learn, but it doesn't work efficiently for every math concept. If this approach is used to introduce every idea, some important topics won't get enough attention.

The authors say that teachers should only use real-world problems that focus students' attention on the math ideas that the problems are intended to develop.

f. Well-chosen instructional methods – Not all math concepts lend themselves to small-group and discovery learning, say the authors: "For example, mathematical conventions and definitions should not be taught by pure discovery." Teachers' decisions on the best approach should be driven by the content. "Correct mathematical understanding and conclusions are the responsibility of the teacher," says the Common Ground group. Which, of course, depends on…

g. Teacher knowledge – "Effective teaching requires an understanding of the underlying meaning and justifications for the ideas and procedures to be taught, and the ability to make connections among topics," say the authors. "Teaching demands knowing appropriate representations for a particular mathematical idea, deploying those with precision, and bridging between teachers' and students' understanding. It requires judgment about how to reduce mathematical complexity and manage precision in ways that make the mathematics accessible to students while preserving its integrity."

"Well-designed instructional materials, such as textbooks, teachers' manuals and software, may provide significant mathematical support," conclude the authors, "but cannot substitute for highly qualified, knowledgeable teachers."

Following up on this work, the National Council of Teachers of Mathematics (NCTM) recently endorsed a short list of math skills that every elementary and middle school student needs to master at each grade. These "Curriculum Focal Points" are an attempt to bring more focus to the mile-wide, inch-deep curriculum that afflicts so many U.S. classrooms. The NCTM document hasn't been released yet, but here's a sample of how it narrows the essential core of math at each grade level to no more than three major topics

- Second grade:
  - Addition and subtraction
  - Place value
  - Linear measurement
- Fourth grade:
  - Multiplication
  - Fractions and decimals
  - The concept of area

Of course other topics are touched on at each grade (for example, probability in fourth grade), but they take a back seat to the fundamentals, which should be taught for 80-90% of the year, resulting in deep understanding of the concepts and skills involved.

"Finding Common Ground in the U.S. Math Wars" by Jeffrey Mervis in *Science*, May 2006 (Vol. 312, # 5776, p. 988-990)
http://www.cptm.us/Common%20Ground%20-%20Science-1.pdf
Common Ground's website is http://www.maa.org/common-ground/; with several articles.

3. Math Skills Are Not Enough: Teach Big Ideas Too!

In this thought-provoking paper written for the Noyce Foundation, California mathematics educator Randall Charles says it's not enough to slim down the mile-wide, inch-deep U.S. math curriculum to a few key topics at each grade level. We must also identify the big ideas and essential understandings underlying those skills, he says, and quotes approvingly from the 1999 California math framework:

- "Mathematics makes sense to students who have a conceptual understanding of the domain."
- "Teachers should guide students to think about why mathematics works in addition to how it works."

Here's an example of a teacher who *hasn't* identified big ideas: Asked what he wants his students to understand about comparing fractions, he says, "I want my students to know how to compare 3/4 and 7/8."

What's missing in this classroom and all too many others is the underlying idea that links this discrete skill to a broader concept – what Yale professor Roger Howe calls "the connective tissue of mathematics."

Charles gives us a "concept attainment" quiz: What is the big idea behind these different problems and solutions:

- How many ways can you name 6?
  - 5 and 1
  - 4 and 2
  - 2 and 2 and 2
- How can you factor 24?
  - 24 = 4 x 6
  - 24 = 2x2x2x3 (prime factorization)
- 3x + 12x = ?
  3x + 12x = 9
- $\sin(\theta + \pi/2) = \cos\theta$
  $1 + \cot^2\theta = \csc^2\theta$

Got it? You're right. The big idea is *equivalence*. A given number, measure, expression, equation, inequality, or function can be represented symbolically in more than one way, with each representation having the same "value." Or, to put it more simply: Changing the way it looks doesn't change the value.

Why are big ideas important? First, says Charles, they promote understanding for ALL students. If teachers work from a good understanding of the underlying big ideas, more students will "get it." In the words of James Stigler, "We understand something if we see how it is related or connected to other things we know."

Second, big ideas are essential to effective teaching. "You cannot teach for understanding unless you understand the mathematics you're teaching," says Charles. Good teachers anchor their math content knowledge in big ideas and use them as a glue for teaching, learning, and assessments.

The problem is that most state standards are skill-oriented, and this promotes narrow, skill-oriented teaching. Here's an example from California's kindergarten standards: "Count, recognize, represent, name, and order a number of objects (up to 30)." Looking more deeply, here's what students need to understand to really *get* this standard:

- When counting, the last number word you say tells the number of items in the set.
- Counting a set in a different order does not change the total.
- There is a number word and a matching symbol that tell exactly how many items are in a group.

Here's another example from California's grade 4 math standards:

1.3 – Round whole numbers through the millions to the nearest ten, hundred, thousand, ten thousand, or hundred thousand.

2.1 – Estimate [by rounding] and compute the sum or difference.

Students might be asked to apply these standards to solve the following problem:

Use rounding to estimate 439 + 578.

A skill-oriented approach to this problem might lead a student to reason as follows:

"4 or less, round down. 5 or more, round up.

439 rounds to 400.

578 rounds to 600.

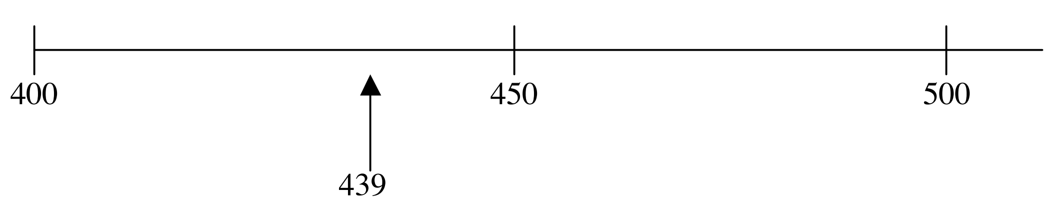
400 + 600 = 1,000.

So 439 + 578 is about 1,000."

Students can certainly get the right answer using this approach, but they are more likely to be tricked by the misleading 9 in 439 and come up with 1,100 as the answer.

Here's a big idea approach to the same problem. The first big idea is that calculations can be approximated by replacing numbers with ones that are close and easier to compute mentally. The second big idea is that rounding is based on knowing the halfway point on a number line between two multiples of 10, 100, 1,000, etc. Numbers to the left of the halfway point are closer to the lower multiple and round down, and numbers to the right are closer to the greater multiple and round up. By mathematical convention, numbers exactly half way in between round up.

A student using an "understandings" orientation might reason as follows: "How can I estimate 439 + 578 by replacing one or both numbers with ones that are close and easy to compute mentally?" The student would be more likely to draw or visualize a diagram like this and not get tripped up by the 9:



Third, big ideas provide deep understanding and curriculum coherence. "Students who do not have a deep understanding of mathematics suspect that it is just a jumble of unrelated procedures," says the California math framework. Charles believes that big ideas and deeper understanding develop through mathematical reasoning. When reasoning is the vehicle,

- Concepts and skills make sense.
- Concepts and skills are remembered.
- Concepts and skills are more effectively used in problem-solving situations.
- Learning gaps and misconceptions are addressed with "reasoning" as the vehicle.

Charles recommends moving students from (a) concrete, real-world situations to (b) using diagrams to create a visual representation of the problem (as above), to (c) abstract number sentences. Sketching diagrams is a vital bridge for students solving problems like this one:

Willie's total came to $11.90. He pays with a $20 bill. How much change will he get?

According to Yancey, Thompson, and Yancey (1989), "Training students in the process of using diagrams to solve problems results in more improved problem-solving performance than training students in any other strategy." Another key element in good math teaching: "Give kids a chance to reason!" says Charles.

The article ends with six recommendations for redesigning a district's or school's curriculum guidelines:

- Focus on about 20 math topics or lessons for each grade level.
- For each topic, articulate the essential understandings and related big ideas.
- For each topic, articulate important connections.
- Identify curriculum focal points.
- Approximate the number of days of instruction for each topic.
- Build profession development around big ideas and understandings.

"New Directions for Standards, Curriculum, and Assessment" by Randall Charles (Noyce Foundation, March 2006):
http://www.noycefdn.org/math/documents/CharlesMathNetworkmeeting32906.pdf

4. Computer-Chosen Cold-Calling in High School Math Classes

This article from the *University of Florida News* reports on a study of teachers using a handheld computer to randomly decide which students get called on in math classes. According to a study conducted by Paige Allison, a Florida high-school math teacher, for her doctoral dissertation, this approach made a big difference in students' level of preparation and attentiveness. "The interview data from the teachers and students show this technique helped students do those things that we know help them be successful in school," said Allison; "paying attention, being prepared for class, staying focused and doing homework."

Allison decided to conduct the study after reading a newspaper account about the way many teachers call on boys more than girls. "There is real, although subtle intimidation that takes place in the classroom reinforcing the idea that women and minority students cannot do math as well as white male students," said Allison. "Research has shown that teachers not only tend to call on white male students more frequently than other students, but they respond to their questions and requests for help differently and provide them with entirely different experiences in the classroom."

"People aren't aware of how hard a teacher physically has to work, not only to manage but to actually teach 150 students a day," she continued. "As in any activity, the natural tendency is to want to conserve energy. It's easier and faster to let the student who knows the answer respond to you. So the quiet person in the corner who doesn't raise a hand doesn't get called on as much." Calling on students can also be a behavior control device, with teachers calling on students to keep them on task or stop misbehavior.

Interestingly, Allison's study of 26 classrooms (15 using the random name-generating device and 11 not) found little difference in the students teachers called on. Apparently teachers in the study didn't show bias in calling on one gender or ethnic group (at least not while they were being monitored by Allison). But the study showed marked differences in whether students were paying attention in class. "They felt they had to tune in more because they knew they had a chance of being called on for every question," reports Allison. Teachers also noticed the difference.

"UF Study: 'Don't Call Us, We'll Call You' Class Tool May Aid Math Students" by Cathy Keen in University of Florida News, May 21, 2006,
http://www.news.ufl.edu/2006/05/17/math-tool

5. A Study of Three High-School Reform Models

This MDRC study by Janet Quint looked at three reform models that attack the basic problems of high-school reform:

- How to prepare underachieving ninth graders for the rigors of high school;
- How to get students ready for college and employment;
- How to create a personalized learning environment;
- How to improve instruction;
- How to stimulate reform.

Below are the three reform models studied, with their key features and the study's findings for each one:

• *First Things First* – Key program features: (a) schoolwide thematic small learning communities; (b) a faculty advisory system (called "family advocate"); and (c) instructional improvement efforts. Study findings: there was an increase in student attendance and graduation rates, a reduction in dropout rates, and improved performance on state tests of reading and math in the initial site in Kansas City, Kansas; there were mixed and inconclusive results at the expansion sites, where the program was in operation for only two or three years.

• *Talent Development* – Key program features: (a) a ninth-grade "Success Academy;" (b) career academies for upper-grade students; (c) an extended block schedule; and (d) catch-up courses in reading and math for low-achieving ninth-grade students. Study findings: the double-blocked schedule allowed students to take a year's work in one semester and helped them catch up on key courses; there were substantial gains in ninth-grade academic course credits earned and promotion rates; these gains were sustained in the upper grades; and math test scores improved.

• *Career Academies* – Key program features: (a) school-within-a-school structure; (b) integrated academic and occupational curriculum; and (c) employer partnerships with career awareness activities and work internships. Study findings: Small learning communities led students to believe that their teachers knew and cared about them; young men in Career Academies who were at medium or high risk of dropping out had higher post-graduation earnings; the program had no effect on high-school graduation or enrollment in postsecondary education.

In addition to these program-specific findings, Quint's study made three other observations:

- Longevity – Comprehensive reform programs that were in place for at least five years had the strongest effects on schools.

- Curriculum – "It may not be realistic to expect teachers to create their own thematic curricula; instead, they are likely to benefit from well-designed curricula and lesson plans that have already been developed. Teachers said they had neither the time nor training to integrate the theme of their small learning communities into their classes, and field research observations and interviews indicate that thematic instruction was uncommon."

- Teacher team meetings – A key to boosting student achievement is teachers working together to align curriculum with standards, review assignments for rigor, and discuss ways to make classroom activities more engaging. But meetings were not always productive. "Researchers' observations of teacher meetings in small learning communities revealed that without specific direction about how to spend their time together, teachers talked mostly about matters unrelated to instruction (such as discipline, individual students' personal or academic problems, or upcoming field trips or parties). If administrators want teacher meetings to focus on instructional improvement, they must provide guidance about how to do this and follow up to ensure that meeting time is used productively."

"Research-Based Lessons for High School Reform: Findings From Three Models" by Janet Quint in *Principal's Research Review*, May 2006 (Vol. 1, #3, p. 1-8), no e-link available but the synthesis report and the individual reports on the three reform models are available at http://www.mdrc.org/publications/428/overview.html. In addition, Quint can be reached at janet.quint@mdrc.org

6. A Teacher Fine-Tunes Her "Do Now"

In this Project for School Innovation (PSI) newsletter article, Boston high-school teacher Karen Crounse reports on an action research project she designed when her beginning-of-class Do Now became a "disaster."

She started by reflecting on why she was doing the Do Now in the first place. It was not just as a ritual to get students engaged at the beginning of class, but also an opportunity for her to pose a challenging math problem, have students practice skills that had been previously taught, and activate prior knowledge for upcoming topics. The procedure was for students to work independently on the question of the day for a few minutes; then Crounse randomly selected a student to present his or her solution. After the presentation, other students asked questions to clarify solutions.

This worked some of the time, but at other times it didn't. If a student presenter was unsure how to solve the problem, Crounse said things degenerated into a "quagmire of confusion," with other students raising their hands to help out, the presenter trying to jot down ideas they suggested, and the rest of the class losing focus. "The work on the board was disorganized," she confesses, "and in some cases, students copied down incorrect statements. It was clear on these days that the Do Now was not effective."

Crounse decided to revise her objectives. She hoped that the Do Now could be changed to improve student engagement, deepen understanding of the question and solution, help students build a resource binder of problems and solutions, and give students a chance to practice both presentation and audience skills. Here's the new procedure Crounse decided to try, using her action research project to monitor the results:

- Students begin silently working on the Do Now question.
- Crounse randomly selects a student to be the presenter of the day.
- This student chooses a "lifeline" peer to help prepare for the presentation.
- The two students leave the classroom to organize the presentation.
- The rest of the students pair up and exchange papers, comparing and commenting on each other's solutions and formulating the best answer they hope to hear from the presenter and a question to ask to see if the presenter truly understands the problem.
- The presenter returns, presents, and is graded using a presentation rubric.
- The other students ask questions and have a follow-up discussion. They are graded on their Do Now assignment.
- Grading is done by a rotating student who serves as class record keeper.
- The main segment of the class begins.

The action research project is designed to evaluate how effective this new design is. Crounse will analyze students' Do Now and assignment grades and test scores, along with her own impressions of student engagement and understanding.

How effective do you predict this new procedure will be? Do you have feedback for Crounse?

"Evaluating the Effectiveness of the Do Now Process" by Karen Crounse in Project for School Innovation Newsletter, May 2006. Crounse teaches high-school math at Codman Academy in Boston.

7. Short Item:

Math lesson on plotting demographics – This is a lesson plan from the National Council of Teachers of Mathematics (NCTM) website. Click around on the site and you will find many more! http://illuminations.nctm.org/LessonDetail.aspx?ID=L238

Do you have feedback? Is anything missing?

If you have comments or suggestions, if you saw an article or web item in the last week that you think should have been summarized, or if you would like to suggest additional publications that should be covered by the Marshall Memo, please e-mail: kim.marshall8@verizon.net

About the Marshall Memo

Mission and focus:

This weekly memo is designed to keep principals, teachers, superintendents, and others very well-informed on current research and effective practices in K-12 education. Kim Marshall, drawing on 36 years' experience as a teacher, principal, central office administrator, and writer, lightens the load of busy educators by serving as their "designated reader."

To produce the Marshall Memo, Kim subscribes to 44 carefully-chosen publications (see list to the right), sifts through scores of articles each week, and selects 5-10 that have the greatest potential to improve teaching, leadership, and learning. He then writes a brief summary of each article, pulls out several striking quotes, provides e-links to full articles when available, and e-mails the memo to subscribers every Monday (with occasional breaks; there were 50 issues in 2004-05).

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- How to change access e-mail or password

Publications covered

Those read this week are underlined.

American Educator
American School Board Journal
<u>ASCD SmartBrief</u>
Atlantic Monthly
<u>Boston Globe</u>
CommonWealth Magazine
District Administration
Ed. Magazine
EDge
Education Digest
<u>Education Gadfly</u>
Education Next
Education Update
Education Week
Educational Leadership
Educational Researcher
Edutopia
Elementary School Journal
Harvard Business Review
Harvard Education Letter
Harvard Educational Review
JESPAR
<u>Jimmy Kilpatrick</u>
Journal of Staff Development
Language Learner
Middle Ground
Middle School Journal
NASSP Bulletin
<u>New York Times</u>
<u>New Yorker</u>
<u>Newsweek</u>
<u>PEN Weekly NewsBlast</u>
Phi Delta Kappan
Principal
Principal Leadership
<u>Principal's Research Review</u>
Reading Research Quarterly
Reading Today
Rethinking Schools
Review of Educational Research
Teacher Magazine
Teachers College Record
Theory Into Practice
<u>Times Educational Supplement</u>