Elementary age students bring lots of things to school with them—besides huge backpacks stuffed with supplies. They bring ingenuity, intuitive knowledge, and mathematical insight. They sometimes amaze their teachers with innovative ways to solve problems. When mathematics teachers link their classroom instruction to students’ intuitive knowledge, students can take classroom instruction a lot farther.

Tapping and nurturing that ingenuity and intuition is the idea behind Cognitively Guided Instruction. CGI is an elementary-level mathematics professional development program developed at WCER in the 1980s and 1990s by education professors Eliz Fennema and Tom Carpenter and colleagues Megan Franke, Linda Levi, Susan Empson and Victoria Jacobs.

What is CGI?

In a typical CGI math problem young students are presented with a problem like this:

Robin has $5. How many more dollars does she have to save to have enough money to buy a puppy that costs $12?

The teacher asks students to think about ways to solve the problem. A variety of student-generated strategies are used to solve this problem such as using plastic cubes to model the problem, counting on fingers and using knowledge of number facts to figure out the answer. The teacher then asks the students to explain their reasoning process. They share their explanations with the class. The teacher may ask the children to compare different strategies. Children are expected to explain and justify their strategies, and the children, along with the teacher, take responsibility for deciding whether a strategy that is presented is correct.

How unlike rote instruction this is. For one thing, it puts more responsibility on the students. Rather than simply being asked to apply a formula to several virtually identical math problems, they are challenged to find their own solutions. Second, they are expected to publicly explain and justify their reasoning to their friends and the teacher. Third, teachers are required to open up their instruction to students’ original ideas, and to guide each student according to his or her own developmental level and way of reasoning.

Expecting students to solve problems with strategies that haven’t been taught to them and asking students to explain and justify their thinking has a major impact on students’ learning. Not only are
We live in a world of inequities. It may always be so, but education can provide some remedy. From an ethical perspective and from a public policy perspective, it makes sense to address inequities as early as possible in a child’s life.

Policymakers and educators know that it’s less expensive to educate a child for 12 years than it is to imprison an adult for 12 years. It’s crucial to provide young students with strong foundations that will bolster their success in subsequent grades and in their adult lives.

In this issue of Research Highlights you’ll see multiple instances of ways education research addresses inequities. More than ever, schools must address the needs of students whose native language is not English. Fifteen states work with WCER’s WIDA consortium to set standards for curriculum and assessment for English Language Learners.

It’s not equitable to offer boilerplate curriculum and instruction and to expect all students to do equally well. The best educators customize instruction to children’s individual strengths and needs. The Cognitively Guided Instruction program for elementary grades mathematics was developed here at WCER in the 1980s and 1990s. It continues to help educators recognize and build on the skills and knowledge children bring with them into the classroom.

And finally, we consider the state of equity in American education looking back on the 40th anniversary of the Equality of Educational Opportunity report, also known as the Coleman Report.

Adam Gamoran
WCER Director
Professor, Sociology and Educational Policy Studies

students learning specific ways to solve problems, they are also increasing their knowledge of the fundamental principles of mathematics. For example, students who learn the standard addition algorithm often learn little more than a procedure to find the correct answer. Students who develop their own strategies to solve addition problems are likely to intuitively use the commutative and associative properties of addition in their strategies. Students using their own strategies to solve problems and justifying these strategies also contributes to a positive disposition toward learning mathematics.

CGI is based on research that shows that children come to school with rich informal systems of mathematical knowledge and problem-solving strategies that can serve as a basis for learning mathematics with understanding. A major goal of CGI is to help teachers build on this informal mathematical knowledge so that they understand the new ideas that they are learning. Because this method of teaching is innovative, CGI offers classroom teachers help in understanding how children’s mathematical ideas develop. The focus is on children’s thinking, not on specifying teaching procedures or curriculum materials. Teachers learning to use the CGI method are given intensive professional development. They bring in examples of their students’ work. They share them with other teachers, examining and discussing student work, sometimes realizing they have underestimated their students.

CGI continues to grow

Graduates of the CGI research and development team are now professors, instructors, and consultants, helping teachers implement CGI in more classrooms.

One CGI alum is Linda Levi, now an education consultant based in Madison, Wisconsin. While a researcher at WCER, Levi saw a large demand for CGI professional development. She determined to do something to increase the availability and quality of CGI professional development. “WCER had no central clearinghouse for workshops, and no control over quality over what others were doing,” she says. She now provides systematic professional development, working with the nonprofit Teachers Development Group in Oregon, which specializes in kindergarten through 12th grade mathematics teacher professional development. She supervises 15 people who provide workshops across the country.

Why this demand? In part, because the No Child Left Behind Act pressures states to meet Adequate Yearly Progress (AYP) goals. Levi points to Arkansas and Iowa as two proactive states that are seeking research-based instruction and professional development in mathematics. Educators in these states are working at the state level to develop local capacity so they can provide their own CGI professional development.
Another CGI alum, Megan Franke, is associate professor of Urban Schooling at UCLA. Franke’s current research builds on earlier CGI studies that showed that students in CGI classrooms solve a wider variety of word problems, use a wider range of strategies, and recall their number facts better than their peers in control groups. Franke says that listening to students’ mathematical thinking has transformed the teachers in her studies into learners. Her work aims to create new communities of practice with teachers, administrators, and her research team.

Working with one school over a 4-year period enabled Franke and her colleagues to observe communities of practice and shifts in participation within them. The teachers in the work groups became much better at detailing students’ mathematical thinking: They not only detailed the strategies the students used but also could analyze the pedagogical practices that supported that student thinking.

The teachers also developed ways of talking with each other about the relationships across the students’ strategies that highlighted the mathematical ideas being developed. Teachers could talk about the relationship between a strategy used in multiplication and a strategy a child used in solving a multi-digit addition problem.

These teachers develop what’s called generative learning; that is, a sense of themselves as learners. In their work groups they talk about their experimentation with problems and they describe and enrich their learning from their expectations.

**Conclusion**

When emeritus professor Thomas Romberg talks about the CGI approach, he sometimes sounds like an English teacher. He’s passionate about getting young students to talk about the mathematics they do, to explain themselves in the public forum of the classroom, to appreciate the different points of view, and to engage each other and the teacher in talking about their reasoning. Sounds like a literature class, someone suggests. Romberg shrugs his shoulders, smiles, and nods.

For more information:
http://www.wcer.wisc.edu/NCISLA/
Publications/reports/RR00-3.PDF
http://www.promisingpractices.net/program.asp?programid=114
http://www.newark.osu.edu/derchick/cgi.htm
More students than ever come to the classroom speaking a language other than English. Some of them bring solid experience in academic subjects in another language and just need help translating that knowledge into English. Other students bring little educational preparation. They come to the classroom years behind their peers academically. Some have a beginning knowledge of English, while other have none.

English Language Learners (ELLs) are not a monolithic group, and meeting the needs of each student is challenging. Instructional methods aimed at students with good conversational and “academic” Spanish will not be appropriate for students who know only conversational Spanish, for example.

Instruction needs to be designed to help students grow in both academic content knowledge and English language skills. If these are not addressed together, in a way that matches individual student needs, then the student is not served.

This has always been the case, but increased pressure from the No Child Left Behind Act has put schools under the microscope. ELL students’ progress is now measured more closely than ever, and schools not meeting goals are sanctioned.

How can schools assess these students and place them properly? Plenty of vendors offer their own versions of assessment instruments. A few of them meet all NCLB requirements; many do not.

It’s natural for schools to feel isolated in this environment, and they’re looking for help. Some have joined a growing consortium that shares resources and expertise. The World-Class Instructional Design and Assessment (WIDA) Consortium wasn’t even around 10 years ago, but now it involves 14 States and the District of Columbia working to meet NCLB instructional and assessment requirements.

The Consortium began with three states. At that time Timothy Boals and colleagues made their home at the Wisconsin Department of Public Instruction. They knew what the research had to say about instruction for ELLs, and they knew how to help teachers. But when NCLB was signed into law, no ELL assessments would meet all its requirements. The assessments could identify students needing ELL help but could not measure when such services could end. Nor could the assessments claim strong validity or reliability. Although the tests measured students’ conversational language skills they didn’t measure students’ levels of academic, or content, language.

Boals and colleagues sought and found the needed testing expertise at the Center for Applied Linguistics (CAL) in Washington, D.C. Combining the two organizations’ knowledge bases—testing with curriculum and instruction—produced a powerful solution.

The Consortium is now housed at UW–Madison. It has grown from three states to 15 in part because WIDA serves state education departments as a buffer against chronic uncertainties like the ebb and flow in a given state’s personnel with expertise in ELL instruction and assessment. WIDA offers continuing expertise.

NCLB requires ELL standards and assessments to integrate vertically (up through grades) and horizontally (across disciplines). The WIDA English Language Proficiency Standards for English Language Learners (“the Standards”) provide teachers, for the first time, a grid that shows where students should be at each grade level and in each academic subject.

(See TABLE 1: English Language Proficiency Standards, next page).
“In our professional development we don’t just hold up the test and say ‘Here it is.’ We show the power of standards to influence instruction.”

The Standards are content-based ESL strategies. In other words, they merge language skills and content skills. They’re built on best practices. They’re innovative in that they help teachers to think in terms of, “What are these students getting out of my math lesson that helps them not only with math skills, but also with the language of math?”

The Standards encompass five English language proficiency (ELP) standards and provide ELL educators with a curriculum and assessment planning tool for content area objectives: The proficiency-based strands allow educators to gauge where ELLs are and how to appropriately challenge them in reaching the next levels. The content goals are modified as needed to fit state and local standards.

In many districts, Boals says, you may have one ELL specialist. This teacher would see 35 students in four different schools.

Each student may receive 20 minutes of instruction per visit. In districts using WIDA’s resources and standards, the ELL specialist has support and becomes more of a coordinator, helping teachers with the standards and leveraging WIDA’s resources.

WIDA’s Standards are posted online for viewing and download at http://wida.us

In Arrangement #1 the Standards are arranged by standard type, then by domain, then by grade level (in that specific order). In Arrangement #2 the Standards are arranged by either standard type, domain, or grade level. In this arrangement, each table in the combined framework includes the bullet points of the matching classroom and large-scale frameworks tables. The ELP Standards Wizard helps users locate particular ELP standards of interest.

Charlene Rivera, executive director of George Washington University’s Center for Equity and Excellence in Education, examined WIDA’s assessment known as ACCESS for ELL, which measures students’ annual gains (and meets NCLB assessment requirements). Rivera says it’s well done (Education Week, 21 July 2006). “You have to look at whether, in the end, people learn something about instruction—about language proficiency and the extent to which instruction is linked to it,” Ms. Rivera said of the test.

<table>
<thead>
<tr>
<th>GRADE LEVEL</th>
<th>LEVEL 1 Entering</th>
<th>LEVEL 2 Beginning</th>
<th>LEVEL 3 Developing</th>
<th>LEVEL 4 Expanding</th>
<th>LEVEL 5 Bridging</th>
</tr>
</thead>
<tbody>
<tr>
<td>K–2</td>
<td>position manipulatives or realia according to oral commands such as to show spatial relations (e.g., “Put the book on the table.”)</td>
<td>position manipulatives or realia according to multiple oral commands such as to show spatial relations (e.g., “Put the cubes in a row across the paper.”)</td>
<td>follow verbal directions by comparing them with visual or nonverbal cues from teachers or peers (e.g., “Fold paper in half &amp; place it on your table the long way.”)</td>
<td>follow verbal directions without visual or nonverbal support (e.g., “Put your name on the top line of the paper.”)</td>
<td>follow sequence from verbal directions without visual or nonverbal support (e.g., “Put your name on the left-hand side of the paper, then put the date on the right-hand side.”)</td>
</tr>
<tr>
<td>3–5</td>
<td>identify materials needed to complete tasks from realia and oral statements</td>
<td>match materials or resources needed to complete tasks with their uses based on realia and oral directions</td>
<td>select materials or resources needed to complete tasks based on realia and oral descriptions</td>
<td>sequence use of materials or resources needed to complete tasks based on oral directions</td>
<td>evaluate use of materials or resources needed to complete tasks based on oral discourse</td>
</tr>
<tr>
<td>6–8</td>
<td>follow commands or identify positive and negative behaviors from illustrations and oral statements (such as in school, on the playground, in gym class, or on the bus)</td>
<td>role play or identify examples of etiquette and manners associated with activities based on illustrations &amp; oral descriptions (such as sports rules or turn taking)</td>
<td>role play positive ways of interacting socially and culturally based on oral descriptions</td>
<td>role play or identify situations of peer pressure based on oral descriptions</td>
<td>role play consequences of succumbing to peer pressure based on oral scenarios</td>
</tr>
<tr>
<td>9–12</td>
<td>follow instructions or requests from peers (e.g., “Meet me at my locker after 9th period.”)</td>
<td>follow conversations (e.g., telephone), process and respond to announcements over the intercom or by teachers</td>
<td>process and respond to discourse from unfamiliar speakers (such as at assemblies or on field trips)</td>
<td>process and respond to discourse from indirect sources (such as cassettes or CDs)</td>
<td>evaluate the appropriateness of messages or information from a variety of sources</td>
</tr>
</tbody>
</table>

English Language Proficiency Standard 1: English language learners communicate in English for SOCIAL AND INSTRUCTIONAL purposes within the school setting.

Domain: LISTENING—process, understand, interpret, and evaluate spoken language in a variety of situations.
The Coleman Report, Forty Years On

Recent papers by UW-Madison professors Adam Gamoran and Geoffrey Borman review the 1966 “Equality of Educational Opportunity” report on the 40th anniversary of its publication, and both reach provoking conclusions.

Published in 1966, the EEO report is also known as the Coleman Report, after its principal author, sociologist James Coleman. It found that U.S. schools were highly segregated and noted inequalities in American public schooling, not only between schools but also within schools.

The Coleman Report was authorized as part of the Civil Rights Act of 1964 and was conceived within the context of the legal system’s growing reliance on social science to inform legal decisions, most notably Brown v. Board of Education of Topeka.

In the decades following the report’s publication there was a dramatic drop in school segregation in the Southern U.S. There also was a significant decline in the proportion of Black students attending 90-100% minority schools in the nation as a whole. But the gains in desegregation peaked in the 1980s and were practically reversed in the 1990s.

Gamoran’s paper finds that:
- According to some indicators, levels of segregation are nearly as high today as they were in 1966.
- Although Black-White achievement gaps are smaller today than they were in 1966, they remain substantial.

**Note:** WIDA is not the only ESL-focused program in the School of Education. The ESL program within the School’s Department of Curriculum and Instruction engages aspiring ESL teachers in the critical exploration of tools for teaching; theories (and the application of theories) of second language acquisition; ways in which schools, communities, and individuals construct specific language and literacy practices and the implications of those practices; and the interplay of discourses in situated social encounters.

**Today's Students**

- **Nearly 20 percent of school children ages 5-17 speak a language other than English at home.**

- **Nearly 5 percent of school children ages 15-17 speak a language other than English at home and have difficulty speaking English.**

- **Within the next three years, more than 30 percent of all school age children will come from homes in which the primary language is not English.**
Going to a high-poverty school or a highly segregated African American school has a profound effect on a student’s achievement outcomes, above & beyond the effect of his or her individual poverty or minority status.

Newer and more sophisticated analytical methods have allowed researchers to mine Coleman’s original data and to tease out more specific information than was apparent 40 years ago, uncovering more striking realities.

UW-Madison education professor Geoffrey Borman has separated differences in student achievement that can be attributed to students’ individual backgrounds from the school’s social composition. Borman says these differences provide evidence that going to a high-poverty school, or a highly segregated African-American school, has a profound effect on a student’s achievement outcomes, above and beyond the effect of his or her individual poverty or minority status.

In particular, Borman found that

- Even after taking into account students’ family background, a large proportion of the variation in student achievement can be explained by school characteristics. Fully 40% of the differences in student achievement can be found between schools.

- Inequalities in student achievement within schools are explained in part by teachers’ biases favoring middle-class students and by schools’ greater reliance on academic and nonacademic tracking.

Gamoran’s study, coauthored with Daniel A. Long, Department of Sociology, Wesleyan University, concludes that contemporary policies could bring about equal opportunity in two ways. First, policies could be enacted across the board that have greater benefits for disadvantaged students than for their more advantaged peers. Second, policies that have similar effects on all students could be focused mainly on disadvantaged students. The school choice provision of NCLB may fit the first category, in that private schools have in some studies been shown to benefit minority students more than other students. NCLB policies on teacher qualifications, evidence-based practice, and tutoring may fit the second category.

Borman’s study, coauthored with WCER researcher N. Maritza Dowling, concludes that “going to a high-poverty school or a highly segregated African-American school has a profound effect on a student’s achievement outcomes, above and beyond the effect of his or her individual poverty or minority status. Specifically, both the racial/ethnic and social class composition of a student’s school are approximately 150% more important than a student’s individual race/ethnicity or social class for understanding educational outcomes. In dramatic contrast to previous analyses of the Coleman data, these findings reveal that school context effects dwarf the effects of family background.”

Borman’s report was written with the support of a National Academy of Education/ Spencer Postdoctoral Fellowship award. Other funding was provided by the Center for Research on the Education of Students Placed At Risk (CRESPAR) and by a grant from the U.S. Department of Education, OERI, National Institute on Educational Governance, Finance, Policymaking and Management.

SOURCES:
Adam Gamoran and Daniel A. Long

Borman, Geoffrey, and N. Maritza Dowling
Schools and Inequality: A Multilevel Analysis of Coleman’s Inequality of Educational Opportunity Data
(paper available on request: contact pbaker@wisc.edu)