DOCUMENT RESUME

ED 458 716 EA 031 434

TITLE	Cognitively Guided Instruction & Systemic Reform.
INSTITUTION	Wisconsin Center for Education Research, Madison.
SPONS AGENCY	Office of Elementary and Secondary Education (ED), Washington, DC.
PUB DATE	2000-00-00
NOTE	32p.; Theme issue. Published biannually.
AVAILABLE FROM	Center Document Service, Wisconsin Center for Education Research, School of Education, University of Wisconsin-Madison, 1025 W. Johnson St., Room 242, Madison, WI 53706. Tel: 888-862-7763 (Toll Free); Tel: 608-265-9698; Fax: 608-263-6448. For full text: http://www.wcer.wisc.edu/publications/pub_online.htm.
PUB TYPE	Collected Works - Serials (022)
JOURNAL CIT	The Newsletter of the Comprehensive Center-Region VI; v5 n2 Fall 2000.
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Academic Achievement; *Cognitive Development; Educational Change; Educational Environment; Elementary Secondary Education; Evaluation; *Instructional Design; *Instructional Effectiveness; Limited English Speaking; *Professional Development; Public Schools; Student Improvement; *Teacher Effectiveness

ABSTRACT

This issue contains an interview with Elizabeth Fennema in which she explains that decades of research on learning has had a minor impact on what goes on in the schools. She and other researchers decided to try to integrate the study of teaching along with the study of learning. Their desire was to effect real change in the classroom and to enhance mathematics learning and achievement for students. Two articles are included by Gloria Ladson-Billings; one is a talk given at the 1999 Cognitively Guided Instruction (CGI) Institute for Teachers in which she outlined how incorporating CGI instructional practices can radically change education at the school; the other article is her talk given at the 1998 CGI Institute for Teachers. A CGI classroom vignette is presented that depicts how a teacher might incorporate assessments into instruction and could make some decisions based on what he or she is learning about students. Another article explains how Fargo, North Dakota, has become a safe haven for Bosnians, Serbians, Croatians, Albanians, and Macedonians, and how the ensuing problems related to English-language learners have challenged the school district. A similar situation applies to Dearborn, Michigan, which has experienced an influx of Arabic-speaking pupils. CGI student-achievement evaluation findings for Region VI are provided. (DFR)

THE NEWSLETTER OF THE COMPREHENSIVE CENTER–REGION VI

[Cognitively Guided Instruction & Systemic Reform]

Volume 5, No. 2

Fall 2000

REGION VI

COMPREHENSIVE CENTER–REGION VI

WISCONSIN CENTER FOR EDUCATION RESEARCH
THE SCHOOL OF EDUCATION
UNIVERSITY OF WISCONSIN–MADISON

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REFORMING AN ECOSYSTEM THE ROLE OF PROFESSIONAL DEVELOPMENT

[walter g. secada]

THE MOST COMMONLY EXPRESSED IDEAS ABOUT SYSTEMIC REFORM SEEM TO IMPLY THAT SCHOOL SYSTEMS ARE LITTLE MORE THAN HUGE MACHINES WHICH CAN BE CHANGED BY: A. MODIFYING WHAT THE MACHINERY WORKS ON (INPUT), B. CHANGING HOW THE MACHINERY WORKS (PROCESS), OR C. BY BETTER SPECIFYING OR REDEFINING WHAT THE MACHINERY IS SUPPOSED TO PRODUCE (DESIRED OUTPUT). INDEED, UNTIL RECENTLY, POLICYMAKERS AND DISTRICT ADMINISTRATORS HAVE TRIED TO REFORM ENTIRE SCHOOL SYSTEMS BY MANIPULATING INPUTS AND/OR PROCESSES — FOR EXAMPLE, BY SPECIFYING HOW MUCH MONEY SCHOOLS RECEIVE PER PUPIL (INPUT), WHAT MATERIALS AND CURRICULUM GUIDES WILL BE ADOPTED (INPUT), THE INSTRUCTION THAT STUDENTS RECEIVE (PROCESS), OR THE CATEGORICAL PROGRAMS FOR WHICH STUDENTS ARE ELIGIBLE (PROCESS). RECENTLY HOWEVER, THROUGH THE STANDARDS AND ACCOUNTABILITY MOVEMENTS, POLICYMAKERS HAVE SHIFTED TO A FOCUS ON THE SCHOOL SYSTEM'S OUTCOMES AND ON IMPOSED CONSEQUENCES FOR SUCCESS OR FAILURE IN ACHIEVING SPECIFIED OUTCOMES.

More-complex ideas about school systems seem to suggest that school systems are like huge Rube Goldberg machines. That is, school systems are thought to operate as loosely coupled machines in which there is slippage between levels of interest. One set of outcomes serves as input for multiple other processes, and things work in complex and somewhat mysterious ways. Almost like magic, the product pops out at the end of a long, convoluted process. A Rube Goldberg machine may be complex, but it is a machine nonetheless.

How can professional development drive, or even support, the reform of a system so conceived? If school systems are machines, then it would seem that professional development faces the choice of working on one piece of the system at a time (inputs, processes, or outputs) or of trying to change the entire system at once. These choices capture the stereotypical dichotomy between providing professional development (usually in the form of workshops or conferences) to many teachers — either in rapid succession or all at once — versus working with a few teachers in great depth. In the latter case, when one is finished working with those few teachers, it is time to move on.

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SCHOOL SYSTEMS AS ECOSYSTEMS

Suppose that, instead of thinking of a school system as a machine turning out specified output, we think of it as an ecological system much as we think of the world's great ecosystems. An ecosystem is home to many species that are in complex relationships with one another. Some species are in constant competition; some create codependent relationships with one another, and some simply ignore one another almost all of the time. Even within a single species, relationships are complex. In some species there are strict hierarchies, while in others status and roles are much more slippery.

One critical feature of an ecosystem, moreover, is that its components are in dynamic balance. This means that anything that has an impact on one part of the system also has an impact on other parts, upsetting that dynamic balance — which the system then moves to reestablish. The new balanced state is, by definition, different from before by having incorporated a new species or by having adjusted to new or changing conditions.

The idea that schools function as ecosystems is not new. This conception has been invoked to explain the complex, and often contradictory, ways in which school policies interact with one another and ways in which school personnel behave. From the very start of our efforts to help schools improve how at-risk students are taught mathematics, we at the Comprehensive Center – Region VI (CC – VI) have operated on the premise that school systems are ecosystems, giving us a different way of thinking about professional development. In designing our work with teachers, their schools, and their districts, we expect to find the kinds of competing — and often contradictory — policies, practices, and complex relationships that one finds within an ecosystem. As in the case of an ecosystem, we expect these competing demands to be in a dynamic balance among themselves.

Professional development upsets this balance within a school and within its larger system by introducing either a new species or a variant of an existing species — in this case a new practice for the teaching of mathematics — into the ecosystem. Hence, we think of the CC-VI work with individual schools as *seeding* change. We strategically introduce new ways of teaching mathematics, support teachers and their schools in implementing those ideas, then depend on the system's own internal mechanisms to help spread the innovation — while still lending our support.

The Comprehensive Center assumes that professional development will affect the balance of a school's ecosystem and that forces from within the system will act to strike a new balance. Our goal is to help create the conditions for that new balance — a balance in which the introduced species can survive and eventually spread throughout the system. Once the Cognitively Guided Instruction (CGI) mathematics program, for example, has a foothold that will allow it to spread throughout the system, we have — according to our view of schools as ecosystems — engaged in systemic reform.

CREATING A NICHE ENVIRONMENT

For a new species to successfully enter an ecosystem, it must find a niche, a haven, in which to first establish itself. By obtaining commitments from school principals that participating teachers will be encouraged to try the ideas they encounter in the CGI Institutes and by limiting Institute participation to *teams* of teachers, the Comprehensive Center encourages the creation of such niches.

When the teacher teams return to their districts, *they themselves* create those supportive niches by meeting together to discuss how their students solve mathematical word problems, to plan lessons, to discuss their classroom instruction, and to address questions as they arise. Such discussions provide a time and a safe place for teachers to learn from one another as they work with a common mission — enhancing students' learning of mathematics. Principals also support the creation of a niche environment in which CGI can take root by actively encouraging teachers to work together — something they promise to do upon sending groups of teachers to the CGI Institute.

This is indeed what has happened in Fargo, North Dakota and Dearborn, Michigan (districts featured in this newsletter) and in other districts that have sent large numbers of teachers to the CGI Institutes. As these teachers went back to their schools and implemented CGI, the Center provided on-site technical assistance. During these site visits, CC – VI staff a) conducted workshops and facilitated teacher meetings, b) discussed student work samples with teachers, c) helped teachers present word problems orally to individual students and listen as they solved the problems so as to better understand the student's reasoning, and d) discussed any other concerns that teachers might have had.

Recently, the Comprehensive Center – Region VI introduced a specialized web site (www.wcer.wisc.edu/ccvi/cgispider/) with bulletin boards where teachers can pose questions that will be answered by their friends and colleagues from throughout the region. The web site provides a means for CGI teachers to discuss ideas for lessons and stay connected. All these actions helped to establish in schools the niche environments within which new ways of teaching mathematics to at-risk students could take root and flourish.

EXPANDING THE ENVIRONMENT

Once a new species, or variant, has entered an ecosystem, either it a) is driven out of the system altogether, b) stabilizes in its small niche environment and does not spread, or c) expands — slowly at first — throughout the system. In the districts (ecosystems) into which CGI was originally introduced (seeded) two years ago, it has been spreading throughout those districts. This is due, in large part, to the complex relationships among the school systems' own personnel and the infectious enthusiasm of the first group of CGI teachers.

How did this happen? Teachers who

taught next door to the first year's CGI teachers noticed that something had changed. Their colleagues were excited by how they were teaching. Students were joyfully and successfully solving word problems — including difficult and non-routine problems. Non-CGI teachers were recruited to help make classroom sets of manipulatives to support children's problem solving in CGI classrooms. Other teachers and school administrators noticed that children of CGI teachers showed a new interest in mathematics. CGI teacher teams enthusiastically shared their plans and teaching strategies with colleagues who visited their classrooms to see what was happening. Impressed at seeing CGI students solving problems that seemed beyond the reach of typical at-risk students, non-CGI teachers asked — and in some cases demanded — to go to the following year's CGI Institute. They too wanted in on this new way of teaching for the benefit of their students.

Purposefully planning to expand the reach of its mathematics initiative, the Comprehensive Center – Region VI offered an Advanced CGI Institute so that teachers who had been teaching CGI for at least one year could learn about how children engage in more advanced mathematical topics — the ideas of algebra, for example. They also learned how to present the ideas of CGI to their colleagues. Beyond this, a few teachers were invited to co-present — with the people who had, just the year before, been their own mentors — at the beginning CGI Institute.

These schools and districts themselves took steps to expand the reach of the mathematics program. Dearborn sent a large contingency of teachers to talk about their experiences at the 1999 Improving America's Schools Chicago Regional Conference. At least two districts are planning to conduct their own CGI Institutes so that *all* the district's teachers can learn about the program. One state education agency has taken an active interest in supporting teachers' travel to and participation in the Comprehensive Center's CGI Institutes. Another school made it a condition of employment that new teachers receive CGI training.

LESSONS LEARNED

Thinking in terms of an ecosystem and how it changes, the CC – VI has been supporting systemic reform in those school ecosystems in which CGI has taken root and is spreading. Though Cognitively Guided Instruction is a professional development program with a proven track record of increasing student achievement in mathematics, it is still important to continuously monitor its progress. After all, educational reform is full of stories about innovative programs that fail because they simply do not work with one or another population. Our evaluation evidence, based on students' performance in solving word problems and in computation, shows that students whose teachers taught using CGI principles learned more than a comparable group of students whose teachers did not. (See Student Achievement insert.)

The first lesson we learned is how important it is to start small and seed change. Too often, people want to implement change immediately and throughout a school system. The alternative trap is to give up on systemic change in the face of what look like insurmountable odds and to create what are, at best, demonstration sites where teaching is exemplary. Thinking of school systems as ecosystems counseled against both extremes and enabled us to think about reform as a process whereby the improvement of teaching takes root then spreads — slowly but surely — throughout the system. In addition, the hoped-for change accelerated as it took on a life of its own. As teachers became interested in what they saw in their colleagues' classrooms, they became excited at the prospect of creating similar classrooms themselves. Teachers also became learners as they focused on how their students reasoned when solving problems.

Second, we learned it that it is important to realize that school ecosystems have the kinds of complex relationships among their staff that allow innovations to spread. A common complaint often found within a school system is its resistance to change. Certainly, with a machine it is difficult, if not impossible, to change inputs or tinker with the inner process or redefine the desired output and get massive systemic changes. Yet, the same collegial friendships and professional relationships that can work to stifle innovation in a machine can allow it to take root and spread in an ecosystem — provided that teachers see the value in that innovation.

Third, we learned, once again, the importance of providing the opportunities for teachers to study and to improve their own practice. As we seeded CGI, schools provided planning time, and we, from the Center, visited and provided what help we could, but it was *teachers* who effected change. They met, diagnosed student reasoning, planned lessons, and — in a word — did the hard work that spread this program and made it a success. Yet, without ongoing research-based support and evidence of increased student achievement, it is doubtful that the program would have succeeded. Competing species (ideologies, regulations, traditions), with political or emotional support, could have prevented the new species (reformed thinking and practice in teaching mathematics) from spreading — or even from surviving.

Fourth, we learned that it is important to put into place, almost from the very start, the environmental structures that will encourage an innovation to grow. In seeding CGI, the Comprehensive Center obtained commitments from principals that teachers would be encouraged to share what they had learned with their colleagues. We told teachers that we would offer Advanced CGI Institutes so that they, too, could help other teachers learn from what they had done. We invited some CGI teachers to co-present at CGI Institutes offered in Madison by the CC – VI. We also helped districts plan and implement their own CGI professional development opportunities.

Finally, the metaphors we use often define how we see and solve problems. Our thinking of school systems as ecological systems gave us a different way of thinking about professional development — thinking of it as a way to introduce a

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CGI FROM THE BEGINNING

AN INTERVIEW WITH PROFESSOR ELIZABETH FENNEMA

[sherian e. foster]

Elizabeth Fennema is Professor Emeritus in the School of Education and Director of the Spencer Research Training Grant. In the seventies and early eighties, the research of Professor Fennema and her colleagues contributed important information about gender equity in mathematics. Here she talks about the foundational Cognitively Guided Instruction research and the importance of that work.

PROFESSOR FENNEMA EXPLAINED THAT, IN THE MID 1980S, IN SPITE OF ALL THAT WAS KNOWN ABOUT GENDER INEQUITIES IN MATHEMATICS, "EVERY INTERVENTION WE HAD TRIED [TO REDUCE THE ACHIEVEMENT GAP BETWEEN BOYS AND GIRLS] WAS NOT PARTICULARLY SUCCESSFUL." PROFESSOR FENNEMA SAID THAT SHE AND PENELOPE PETERSON HAD WORKED TOGETHER DOING RESEARCH ON TEACHING AND THAT SHE AND THOMAS CARPENTER HAD TALKED "FOR MANY, MANY YEARS ABOUT THE IMPORTANCE OF RESEARCH ON LEARNING." (SEE SUGGESTED READING.) "BUT," SHE SAID, "WE HAVE HAD DECADES AND DECADES OF RESEARCH ON LEARNING THAT HAS NOT MADE MUCH OF AN IMPACT ON WHAT GOES ON IN THE SCHOOLS." FENNEMA, CARPENTER, AND PETERSON, THEREFORE, DECIDED TO "TRY TO INTEGRATE THIS STUDY OF TEACHING ALONG WITH THE STUDY OF LEARNING." THEIR DESIRE, ULTIMATELY, WAS TO EFFECT REAL CHANGE IN THE CLASSROOM AND TO ENHANCE MATHEMATICS LEARNING AND ACHIEVEMENT FOR STUDENTS.

THE ORIGINAL PLAN

Professor Fennema explained: "The overall purpose of CGI, originally, was to do a three-year research project in which we would study the *impact on teachers of their learning about what we knew from research about children's learning and thinking in mathematics*. It was not enough to just study the teaching. We also wanted to study the *impact on learning* of the children in these teachers' classrooms. . . ."

"This went along about as expected for the first couple of years. We had long, involved discussions about how we would help teachers learn about children's learning and what we would tell teachers to do — because almost all curriculum development projects try to tell teachers what to do with information. And that's what we planned to do. We planned to develop some kind of a curriculum based on what we knew about children's thinking, teach it to teachers, and assume they would do what we had told them to do — and that would be it."

A CHANGE IN PLANS

Professor Fennema continued, "But along about the first six months of the project we realized that [telling teachers what to do with knowledge we gave them] was basically in conflict with what we knew about learning and what we knew about teachers." She pointed out that "the fundamental assumption underlying CGI is that you have to make instructional decisions based upon each child's thinking" and added, "It would have been a little bit arrogant of us to think that, before we knew the children, we could tell the teachers what to do in the classroom!"

Professor Fennema said that the principal investigators "realized that, indeed, we did *not* know what teachers should do with this material. It had never been tried before." She continued: "*We decided, as a result — upon really examining our own knowledge of teaching and learning — that the only thing we could do was to help teachers learn about how children learn and then to study what they did with that knowledge.*"

"It turned out to be the best decision we ever made, to be very truthful with you. Teachers have so much knowledge about the practicalities of teaching and about children that they were much better able to implement something than if we had told them what to do."

AMAZING CLASSROOMS

Professor Fennema explained that the principal investigators did not go into the classrooms because "it would have really influenced the results of the study." Near the end of the study, however, after the data were collected, Fennema, Carpenter, and Peterson decided that they themselves had to see what was happening in classrooms in which teachers had research-based knowledge about how children think and solve problems.

Professor Fennema said, "*We could not believe our eyes at the quality of the teaching that was going on*. We realized, at that time, that we had a great deal more in our hands than just a research study. We were amazed. . . . "The classrooms that we first saw do not begin to compare with what we see today, but — compared to what we had both seen before in the elementary schools — they were amazing."

CHILDREN LEARN MATHEMATICS

The most important effect of CGI for children, Professor Fennema said, is that they are learning and "taking a different kind of look at mathematics [than they

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DEVELOPING A "DANGEROUS" PEDAGOGY

TALK GIVEN AT THE 1999 CGI INSTITUTE FOR TEACHERS

[gloria ladson–billings]

ALTHOUGH I FEEL LIKE MY COLLEAGUES HERE AT UW–MADISON IN MATHEMATICS EDUCATION HAVE ACCEPTED ME AS AN HONORARY MATH EDUCATOR, I DO HAVE A CURRICULUM HOME IN SOCIAL STUDIES. MY TRAINING IN SOCIAL STUDIES PROMPTS ME TO LOOK AT MOST ISSUES THROUGH HISTORICAL, GEOGRAPHIC, SOCIAL, POLITICAL, ECONOMIC, OR CULTURAL LENSES. I EVEN SEE OTHER SUBJECT AREAS THROUGH THOSE SOCIAL STUDIES FILTERS. SO, TONIGHT I WANT TO SHARE WITH YOU WHY I THINK INCORPORATING CGI IN YOUR CLASSROOM IS POTENTIALLY A DANGEROUS PEDAGOGICAL MOVE. MY REMARKS THIS EVENING ARE ENTITLED: "COGNITIVELY GUIDED INSTRUCTION: DEVELOPING A 'DANGEROUS' PEDAGOGY." I THINK THERE ARE AT LEAST FIVE REASONS WHY INCORPORATING CGI INTO YOUR INSTRUCTIONAL PRACTICES REPRESENTS A DANGEROUS PEDAGOGY.

Danger Number 1: *Challenging the Status Quo*

First, incorporating CGI is dangerous because it challenges the status quo. *Schools are organized to maintain social and cultural norms. One of those norms is that mathematics is a subject area organized to sift out the best from the rest.* While schools will accept some minimal level of mathematics competence for all students, high level functioning in mathematics seems reserved for an elite few. And, that elite group is restricted to white middle class male students and some Asian American students. Female students, poor and working class students, African American and Latino students, and students who are second language learners often are relegated to a cycle of failure in mathematics.

CGI represents an attempt to interrupt the status quo. This interruption will not sit well with traditional school officials. If everyone can demonstrate greater mathematics understanding, who will be left to fill in the spaces reserved for "basic math," "consumer math," and "math for math phobics?" How will we be able to continue to rank and rate students? How will we know who is "better?" Yes, a serious incorporation of CGI into a classroom is bound to upset the status quo.

Danger Number 2: *Encouraging Students to Think*

Second, incorporating CGI into the classroom is dangerous because it encourages students to think. Now that might sound paradoxical, but I argue that schools are not places where we encourage students to think. Indeed, the late James Baldwin, an esteemed novelist and civil rights activist, argued that no society really wants thinking people. Thinking people raise uncomfortable questions. Thinking people ask for explanations to the contradictions that exist between what we say and what we do. Students who are thinking are quick to ask, "How come...?" "How come our school doesn't have enough books for all the kids? How come we don't have any teachers who can speak our language? How come only a few kids from our school graduate from high school?"

The kind of thinking that students are encouraged to do through CGI is the kind of thinking we hope that students will do in every aspect of problem solving they encounter. Mathematical problems are but a few of the problems that students work to solve each day. How can I stop a big kid from picking on me without looking like a wimp? How can I get my homework done, go to soccer practice, and finish all my chores this afternoon? Does it make more sense to continue to play in the orchestra or should I try out for the basketball team?

CGI's oft heard question, "How did you come up with that solution?" provides a criterion that students can and should use for a variety of problems. Of course, our parents were more likely to ask us, "What in the world were you thinking?" but the cognitive demands are equivalent — how do we come up with the solutions to our problems?

Danger Number 3: *Changing the Curriculum*

Third, incorporating CGI into the classroom is dangerous because it precipitates a change in the curriculum. Most of the research that has investigated the state of elementary mathematics in the U.S. indicates that our elementary mathematics curriculum is filled with rote learning of low level arithmetic. The mathematics in the elementary curriculum is formulaic. Students are required to learn algorithms and rules for basic operations of addition, subtraction, multiplication, and division. Most students learn how to do those algorithms, follow those rules, and remember rote operations. However, most students do not

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have before]. It gives them the ability to understand that they *can* makes sense of mathematics and that *how* they make sense of mathematics is important."

Kindergarten children in CGI classrooms can, for example, solve a problem such as this:

Our class has 3 pages with stickers on them. There are 4 stickers on each page. How many stickers do we have?

In CGI classes, much attention is given to each student's thinking and problem solving strategies, and multiple strategies are encouraged. Professor Fennema continued: "As [students] communicate their strategies — sometimes quite simple strategies, sometimes very complicated strategies — they begin to feel that mathematics is an understandable body of content, that they, indeed, can learn and that it's important to learn. It somehow makes them feel so good about mathematics and about themselves. Plus, obviously, they learn to do mathematics! *We must never forget that the bottom line is that students learn to do mathematics in a way that we had never really thought that children could.*"

TEACHERS ARE PROFESSIONALS

When asked about the most important effect CGI has had on teachers, Professor Fennema said: "*I think the most important thing for CGI for teachers is that they have been given the opportunity and have acquired the knowledge that makes them truly professional. They, by understanding the children's thinking, are able to make decisions that improve learning.*"

Professor Fennema said, "I feel strongly about the impact I've seen on teachers who've become truly professional," and she mentioned several important changes they saw in CGI teachers:

- "Certainly they know their children much better."
- "They begin to think a great deal differently about themselves as teachers. They know that the responsibility [for student learning] is theirs — they've always known that — but now they have the knowledge with which to take that responsibility and do something with it."
- "They have changed the way they teach dramatically." Professor Fennema noted that all teachers with whom they have worked changed, albeit to varying degrees.

Professor Fennema is passionate on this point. She reiterated, "*The knowledge of children's thinking is powerful. It's extremely powerful. It's enabling.*" With a twinkle in her eye, Professor Fennema recalled teachers who have become national leaders and said, "Tom [Carpenter] calls me a 'born-again cockamamie scientist.' I say, 'Maybe I am!'" She quickly added, with professional sincerity, "But I'm not that kind of researcher."

CHANGING A SYSTEM

When asked what recommendations she would give to a school or district trying to implement CGI, Professor Fennema made several points.

Change will come through teachers' professionalism.

Professor Fennema said she supports the approach that Walter Secada and the Comprehensive Center are taking. She emphasized that schools should "not to go into full-scale implementation the first year." Rather, she said, it is important "to get a core group of teachers that understand it fairly well — and the only way to truly understand [CGI] is to teach it a year or so — then facilitate letting those teachers disseminate it to the rest of the school system." *This is possible, Professor Fennema said, because teachers are professionals who know their schools and know how to implement new things in their own settings.*

Teachers are instrumental in bringing administrators along in their understanding of CGI by involving them in the change, said Professor Fennema, and she gave an example. Some teachers "quite often send a child to the principal's office to explain how they solved a problem." This has several benefits. The child is "feeling extremely important because she solved a difficult problem, and she is going down to tell the principal about how she solved it. It only takes two or three minutes for a child to come in and explain a solution strategy, and principals have an interaction that's pleasant with children. They, also, can see what the children are thinking. *I think that what really hooks teachers is children's thinking — but I think it hooks principals, too.*"

Professor Fennema said that she feels having administrators attend CGI workshops is important so they can understand "what CGI really means." That, she said, "means more than just reading about it."

Teachers play a key role in helping parents understand what their children are learning in a CGI mathematics class. Again, Professor Fennema gave an example. One teacher, she said, "would have the children and their parents come to school one night, and everybody solved problems. Then the children would come up in front to the overhead and explain

Schools should not go into full-scale implementation the first year. It is important to get a core group of teachers that understand [CGI] fairly well — and the only way to truly understand it is to teach it a year or so.

[their solutions]. She had to tell the parents, 'Now don't you tell the children how to solve these problems. . . . You sit and see if you can solve them a different way.'" Some teachers "send newsletters home to parents with a solution strategy."

With parents, as with administrators and teachers, it is children's thinking that "hooks them," Professor Fennema said. "Once again — getting the parents intrigued with children's thinking — helping them know that *teaching is not telling* [but is] letting the children have an opportunity to do the exploration on their own." Furthermore, at parent-teacher conferences, "many of the teachers have used the children's thinking in mathematics as a good communication device with parents — rather than talking about some [of the usual] things." Because teachers keep careful track of children's solution strategies, Professor Fennema said, "They can show growth from the beginning of the school year to the end of the school year."

Change takes time.

Implementing CGI involves dramatic changes, Professor Fennema pointed out, but teacher change "doesn't take place in a week, or a month or a year. . . . The *most* growth will take place over a period of several years." She continued, "*one nice thing is that we do see rather immediate growth in children's learning, so they [teachers and schools] can at least be accountable to their parents and to their public that [CGI] is effective.*"

Professor Fennema cautioned, however, that "principals often go with something for two or three years, and, if they're not seeing dramatic results, they say, 'well, we are going to try something else.'" But, because change takes time, she advises that "as long as [principals] see growth in their children and their teachers, they should stick with it."

Change requires a joint effort.

With conviction, Professor Fennema said that *implementing CGI and effecting change is " a cooperative venture between the expert on children's thinking and the people who are out on the firing line of teaching, and we both know important things.*"

And a Teacher Said. . .

"They must be able to witness success in those classrooms–see the outcome of learning in CGI classrooms verses the non-CGI classrooms. If that doesn't sell a teacher, well, I don't know what else will."

She emphasized that the role of those who lead CGI workshops and the CGI Institutes is to share what they know — research-based information on how children think and learn mathematics.

When asked how they help teachers learn to keep track of every child's thinking or get common planning time, Professor Fennema answered, "*We* don't talk about the details of teaching. *Teachers do*." She continued, "I don't think anybody should trivialize what a complex kind of an activity this is." Teachers and their administrators know best how to solve those problems in their own situations, she said.

NEXT STEPS

Professor Fennema explained that, after the first three-year project, they continued the research — expanding CGI through grade three, exploring "the impact of CGI in schools that were basically made up of African-American children," conducting a three-year longitudinal study in Madison of the impact of CGI, and "trying to put it into pre-service teacher education." She emphasized that "the National Science Foundation . . . has been very, very generous, in their funding of this all the way through."

When asked about the next research to be done, Professor Fennema said that she feels the work Tom Carpenter and his colleagues are undertaking to study children's algebraic reasoning in the early grades will be important. Specifically in terms of CGI, she said she would like to see someone investigate the effects of actively moving students toward using more mature strategies — something CGI, to date, has not encouraged teachers to do.

A PASSION FOR EQUITY

Professor Fennema indicated that the latter suggestion for further research stems from her deep and abiding concern for the mathematics learning and achievement of *all* students in general and her concern for gender equity in particular. She said that girls tend to stay with less-mature modeling strategies, while boys move to more-complex strategies — indicating more mathematical understanding. Also, she pointed out, "girls are not doing as well as we would like to have them do in complex reasoning."

Professor Fennema added, "*I should really emphasize is that girls are doing much, much better than they ever did before*. It's not as if the boys have been the ones who have been learning. Everybody's moved along, but there's still a gap in learning between the girls and the boys and between African-Americans and white, and between Hispanics and white, between Native Americans and white. So we've got to somehow do something there."

As for Professor Fennema, she will not be satisfied until *all* achievement gaps have been closed. She concluded hopefully, saying, "*I think that we have enough information that we can begin to make some intelligent recommendations on interventions and to study those interventions*."

Thank you, Professor Fennema, for your years of dedication and research and for your time in granting this interview.

[about the interviewer]

SHERIAN E. FOSTER is a Mathematics Education Specialist and Editor of this Comprehensive Center – Region VI Newsletter.

[continued from page 5]

learn what these operations mean. They do not learn how such operations might help them solve the kinds of problems that are important in their lives.

We know that the elementary mathematics curriculum is vacuous, but we aren't sure why the curriculum is vacuous. My hunch is that we permit such a redundant and intellectually weak mathematics curriculum because we know that we do not prepare elementary level teachers well enough in mathematics to be able to answer the kinds of important mathematical problems that children pose.

If a student were to ask how many cats are in her town, would most elementary teachers know how to go about solving that problem or helping the student to solve the problem? These are the kinds of problems that students want answers to. They could care less if Tim has 5 apples and Sue has 4 apples. Most savvy elementary school students probably look at a word problem like that and say to themselves, "can't those idiots tell how many apples they have — and if they can't then maybe they shouldn't even have any apples."

The thinking that students develop in a CGI classroom is not likely to be constrained to mathematics. Its influence may spread to literacy, science, social studies and other subject areas. Students may begin to ask new questions about the nature of all sorts of social and scientific phenomena. This "bleeding" over into other subject fields is exactly what integrated education should be — not the festival of teddy bears or dinosaurs we see in many classrooms.

Instead, the curriculum might be more like that of one of our former graduate students, Barb Brodhagen. Barb and her teaching partner teach in a seventh grade classroom. Each year they begin the school year by asking the students, "What do you want to know about yourself and what do you want to know about the world?" After students individually answer the questions, they meet in small groups to decide which questions the group thinks are worth investigating. Finally, the entire class hears the specific group questions and votes on those questions that most interest them.

One year, one of the questions that most interested the group was "Will I live to be 100 years old?" This one question plunged the students into in-depth studies of actuarial tables, family histories and genealogies, genetic diseases and hereditary chronic conditions. The curriculum lost its rigid boundaries and fixed shape. Some problems evoked by this question prompted the use of mathematics skills. Others required students to use their literacy skills. Still others required the cultivation of research skills. In the end, the students began to exhibit the kind of critical thinking that we might expect from much older students.

Danger Number 4:
Rendering Instruction Unpredictable

Fourth, incorporating CGI into your classroom is dangerous because it makes instruction less predictable. In today's urban classroom, the last thing many teachers and administrators want is unpredictability. So-called well run urban schools are characterized by their strict disciplinary standards, regimentation, and routine. Teachers in such schools are expected to write out daily objectives and ensure that the students pass state and local assessments. The atmosphere in schools like this is oppressive. The emphasis is not on student learning; rather it is on improving the previous year's test scores to minimize the personal sanctions and public critique.

Teachers who incorporate CGI are willing to be less governed by routine and regulation in their teaching. They are likely to be more open and flexible to new ways of teaching because they will experience students' novel ways of thinking. This is not to suggest that CGI teachers do not plan and prepare their mathematics lessons. But, within that planning they are willing to allow student thinking to guide the lessons in a variety of directions, because this divergent thinking eventually will lead to deeper thinking.

In my own research, I have been interested in studying the pedagogical practices of those teachers who are effective with African American students. I want to know what they do to support the learning of those students whom so many others have insisted can't or won't learn. What I have learned from intensive study of such teachers is that effective teaching requires flexibility and variability. Even when teachers establish a routine around which to organize and structure instruction, within that organization there is tremendous variability. One teacher I studied made it a point to begin each morning with a proverb. Although the use of the proverb was standard, what the teacher did with the proverb varied from day to day. Sometimes the teacher used the proverb to connect with students' home experiences. Other times she used the proverb to stimulate word games. Still other times she used the proverb to help the students write their own proverb.

In CGI classrooms I have observed teachers who begin each day with the same routine — doing the attendance and lunch count. However, each day's mathematics lesson is different. One of the teachers I most enjoy watching, regularly engages her students in social justice issues and activism. One year, the students were doing a lot of name calling on the play yard. Instead of merely scolding the students for name calling, the teacher used their behavior as a catalyst for learning. One name that students regularly used was "AIDS Monster." The teacher developed a unit on AIDS that dealt with the disease in an intellectually honest and forthright way. The teacher, trained in CGI, helped the students develop a series of mathematics problems about the spread of the disease, the cost of care, and the amount of money they raised as a result of the red ribbon sale they conducted. She began her work by paying attention to children's thinking about each other and culminated it by directing their thinking toward substantive cognitive tasks.

Danger Number 5: *Creating Dissatisfaction and Professional Power*

Finally, CGI is dangerous because it creates a level of dissatisfaction among those teachers who begin to discover the power of children's thinking. This dissatisfaction prompts many teachers to greater levels of professional power. So much of our teacher preparation is focused on what we want students to learn and on how to present information and to develop skills. Now, it would be wrong for me to suggest that there is no place for information and skills. Indeed, we live in what has been called an information age and students need to be able to do something with the all the information that comes to them.

However, what I believe is missing from teacher preparation (and as a consequence, from teaching) is the notion that teaching is about engaging with minds and developing professional power and expertise. Granted, those minds with which you engage may not have mastered the information and skills that you have, but they are minds just the same. Too often, we treat students as if they do not have minds — or at least we treat them as if their minds are not sufficient for the kind of intellectual engagement that we value.

What CGI offers to teachers — and students — is the opportunity to use their minds well. Rather than turn over your mind to a textbook publisher, CGI argues that students already have problems that are inherently more interesting and more challenging. *Teachers who encounter those more interesting and challenging problems, brought to them by students, begin to grow weary of the patronizing, meaningless, pabulum that passes for the curriculum.* They begin to grow weary of notions that only some students are capable of high level functioning in mathematics. They grow weary of the idea that teachers have to be told what to do and are, themselves, incapable of learning.

And a Teacher Said. . .

In a disscussion with non–CGI teachers who were decrying counting with the fingers: "It was like peer pressure, and I realized I had these [CGI] people behind me, so I thought, 'O.K., I don't have to give in to this.".

Yes, I think CGI is a dangerous pedagogical practice. It challenges the status quo, it prompts students to think, it precipitates changes in the curriculum, it forces changes in instruction, and it creates a level of dissatisfaction among teachers that allows them to mobilize their professional power and rethink what it means to teach and learn with young students. It is a dangerous pedagogical practice that could fundamentally undermine the way schooling happens in this country. Of course, maybe you think the way schooling occurs in our nation is just fine. I would rather help teachers learn how to do something dangerous.

[about the author]

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A Parent's Experience

Talk Given at the 1998 CGI Institute for Teachers

[gloria ladson–billings]

PART OF MY RESPONSIBILITY THIS EVENING IS TO TRY TO SAY SOMETHING ERUDITE AND COMPELLING ABOUT MATHEMATICS EDUCATION, IN GENERAL, AND COGNITIVELY GUIDED INSTRUCTION, IN PARTICULAR. PERHAPS, BEFORE TONIGHT IS OVER I WILL ADDRESS THIS CHARGE. HOWEVER, I AM MOVED TO DO SOMETHING MORE AKIN TO MY OWN AFRICAN AMERICAN RELIGIOUS TRADITION—TO TESTIFY. *TESTIFYIN'* IN THE AFRICAN AMERICAN TRADITION IS IN NO WAY RELATED TO OUR AMERICAN JURISPRUDENCE NOTION OF A COURT APPEARANCE. INSTEAD OF BEING SUMMONED BY A PROSECUTOR TO RESPOND TO A SERIES OF QUESTIONS, TESTIFYIN' IN THE AFRICAN AMERICAN TRADITION IS OFTEN A SPONTANEOUS, SELF-REVELATORY EXPERIENCE IN WHICH THE SPEAKER ATTESTS TO A PERSONAL MIRACLE. BELIEVE IT OR NOT, MY TESTIMONY IS ABOUT CGI.

When my family and I arrived in Madison in 1991, we knew little about its schools, let alone the specific curricular choices. As a teacher educator and researcher I certainly knew of Elizabeth Fennema and her work examining gender and mathematics. I had used some of her work in my own teaching. But I was woefully ignorant about this thing called Cognitively Guided Instruction.

We enrolled our daughter in the neighborhood school the same way many parents do — unaware and trusting. Our experience with first grade was a good one, or so we thought. The teacher focused most of her energy on teaching the children to read. Mathematics was kind of an afterthought. And, knowing of the centrality of reading in the curriculum, we did not worry too much about the absence of mathematics. Of course there was the requisite learning to count, recognition of numerals, and some basic addition and subtraction facts. Since I had never taught first grade, this all seemed appropriate.

At the end of this first year we were happy. We had a daughter who could read well and had some passing knowledge of what we thought was basic mathematics for first graders. For year two, we found ourselves in another school (due to the purchase of a new home). The philosophy of the school was markedly different from the first. Indeed, school number two had a philosophy whereas our previous school was one in which each teacher functioned as an independent contractor. Your child's schooling experience was wholly dependent upon which teacher s/he received.

In the new school, teachers believed in cross-aged grouping and team teaching. The reading program was literature-based and the early grade mathematics instruction was based on CGI. I was excited about what the school year offered, even if I did not know very much about CGI. As a way to support my daughter in her new environment, I chose to volunteer in her classroom one morning a week, whenever I could. Being an eyewitness to the instruction was crucial.

The year did not start off very smoothly. My 7-year-old was unhappy about the change in approach. Instead of being in a small class of 20 students with one teacher, she was in a large class of 43 students with two teachers. She was a second grader and expected to exhibit more maturity than the younger first graders. Her classroom was not arranged into neat rows of individual desks. It had large tables, a big rocking chair, beanbags, and a carpet. I knew things were not getting off to a good start when, before the first week ended, my daughter announced, "I hate this class. We don't do any work. We just have 'activities' and we don't even have our own desks."

I was willing to be patient with the teaching since I know that pedagogy is a complex thing. Its underlying structure is not easily revealed to students, particularly students who are very young. I beseeched my daughter to give her teachers and the classroom a chance.

Tuesday mornings were my time in the classroom. I witnessed the opening exercises where students took responsibility for recording their attendance by placing the Popsicle stick that had their name on it into a container. Each morning the teacher tossed the sticks on to the carpet. As students arrived, they placed their outerwear in their lockers, found the stick with their name on it and put it back into the container, and circled their name on a pre-printed class list if they intended to have hot lunch.

The teacher began the opening activities by reading the names of the remaining Popsicle sticks. Occasionally, someone who was in attendance shouted, "I'm here. I forgot to put my stick in the can." Remember, these were first and second graders and routine often comes slowly. The teacher would then write the names of the absentees on the board and then ask the question, "How many people are here today?" Within a few seconds, a flurry of hands would wave in the air. Many of the children knew the answer, especially the second graders.

I watched uncomfortably as my daughter sat silently with a puzzled expression on her face. As the teacher called on students, she always asked the question, "how did you get your answer?" These little ones would wax eloquently on how they discovered the answer. "I know there are 43 children in our class. Two are absent, so I counted back, 42...41." Similarly, the teacher posed questions about the number of students who were not getting hot lunch. This problem required students to be mindful of how many students were in attendance for the day and who among today's attendees were getting hot lunch. The children shared ingenious strategies for determining how many children were hot versus cold lunch eaters. The entire exercise would have been fascinating to watch were it not for the fact that my daughter regularly sat there clueless.

One day at home, my daughter expressed how frustrated she was with the attendance and lunch-count activity. "I don't know what they're doing," she lamented. "I'm stupid!" At that moment I switched from university professor/ researcher to anguished mother. It hurt to see my child hurt. I didn't think of the limited exposure to authentic mathematics in grade one as the culprit. I was upset and angry and went straight for the nearest target. I made an appointment to see the teachers and shared my concerns. They responded in a calm, dispassionate way. "Don't worry," they said. "She'll catch on." And, they proceeded to share the theory underlying their approach. I wasn't hearing it. I didn't want theory. I didn't want research. I wanted a sad 7-year-old to be happy again. However, I tried to be reasonable. "Okay, I'll try to be patient," I said.

And a Teacher Said. . .

"It was a struggle. It was painful for the teacher sometimes, and for the students. But we just kept working through it. I'm not going to give this up. I'm going to keep trying and keep trying. Then, one day, its like a glimmer. They're learning. They're progressing."

Several more weeks passed and nothing seemed to change. Now I was more than a little anxious. My daughter's mathematical confidence seemed to be sinking quickly. I wanted immediate results. I marched into Elizabeth Fennema's office and said, "Look! My daughter is in a CGI class and it's a disaster. She's confused and bewildered and the teachers seem not to be helping her. This stuff doesn't work!" Liz asked who my daughter's teacher was, and, when I told her, she assured me that she was in good hands.

By the end of the year I still was unconvinced of the effectiveness of CGI for my daughter. She seemed to be tentative about mathematics. She still was not participating in the opening problem solving. She worried that she did not complete as many story problems as other second graders or some of the first graders. The teachers seemed to think she was making progress. At the spring conference one of the teachers asked my daughter a complex word problem and placed a tray of Unifix cubes in front of her. Within a few moments my daughter used the cubes to form her response. She and I both seemed a little surprised. The teachers were not.

We nervously began third grade. Sometime near the end of the first semester, I saw a renewed confidence in my daughter. She was whizzing through math problems. One day she asked me a rather mundane question like, "how much is 54 minus 17?" I quickly jotted the numbers on a piece of scrap paper and my 8-year-old said, "You mean you need a piece of paper to answer that question? Can't you tell that 54 is almost 55 and 17 is almost 20? Fifty-five minus 20 is 35. You added one to the 54 and you added 3 to the 17. Subtract one from three and add it to your 35. Now you've got 37." I stared at my daughter with astonishment. She had a strategy! She had command of a mathematical problem without a routine algorithm. I realized that she had benefited from CGI. It just wasn't neatly manifested in the span of a 9-month school year. Instead, she had knowledge she could use. I was happy to knock on Liz Fennema's door with an apology.

Last year my daughter wrote an outstanding bubble gum test report for math, plotted a set of coordinates for photos she downloaded from the EarthKam mounted on the Space Shuttle, and built a computerized land rover for a replicated Mars terrain. This year she enters eighth grade in the accelerated algebra class. She loves mathematics and is good at it. She's CGI success story.

LESSONS LEARNED

While the passion of testifyin' lies in the story itself, the power lies in the lessons learned. What then have I learned from my daughter's CGI experience?

(continued on next page)

The first lesson I learned was not to be casual about an anemic mathematics curriculum. My daughter's first grade experience cheated her out of the kind of foundation she needed to exhibit and improve her problem solving skills. It is not enough for students to learn to count and memorize a set of basic number facts. Don't get me wrong. Children do need to develop number sense. They do need to read and recognize numerals. But, children come to school prepared to engage in problems more sophisticated than "Johnny had 2 apples and Terry had 1 apple. How many did they have in all?"

Just as we would not be satisfied with students only learning to recite the alphabet and form little words such as "see, be, me, and we" by the end of first grade, we must demand a mathematics curriculum worthy of our children's minds. As I think about the CGI curriculum — versus the first grade one — I am reminded of a video tape of a ninth grade algebra class I recently viewed. In it, the teacher wrote "16 divided by 4" on the chalkboard. "What does this mean?" she asked. Quickly several students shouted out "4!" The teacher replied, "I didn't ask you what the answer was. I asked you what the expression means." The room fell silent. Students with a deeper understanding of mathematics would not have been so easily stumped.

Second, I learned that when teachers are confident about what they are doing, they are not intimidated by parental distress. My daughter's second grade teachers did not let my distrust of their mathematics program deter them. They were taking careful notice of my daughter's progress. They were less concerned with right-answer thinking than "right" attitudes toward mathematics. I cannot stress enough how important it is for teachers to know what they are doing. I presume my daughter's teachers' training in CGI helped them to assuage the concerns of nervous-Nellie parents like me. Their ability to see the "big picture" kept them plugging along with a student who seemed overwhelmed by a new approach that asked her to use her mind well.

The calendar is a weak standard by which to judge student learning.

Third, I developed new insights on the artificial and arbitrary ways we have organized teaching and learning in our schools. As a parent, I was dependent on the June end of the school year as the final determiner of what my daughter knew and was able to do. The demonstration of her mathematics learning was showcased as "knowledge in use" when she raised a question with me in the midst of her third grade year. The issue is not what grade she received but what knowledge and understanding she had access to. The calendar is a weak standard by which to judge student learning.

Finally, I learned the lesson of "The Algebra Project's," Bob Moses. That lesson is that mathematics is the new Civil Rights battlefield. In the 1960's Civil Rights Activists understood that poor and disenfranchised people of color needed access to literacy in order to exercise their citizen rights. Throughout the nation's south, civil rights workers fanned out to help people learn to read and write. The Citizenship Schools and the Mississippi Freedom Schools were examples of their efforts. Today, the franchise is guaranteed to all citizens. But, many continue to be locked out of a thriving economy. Their inability to make sense of the mathematical codes ensures that they will have limited opportunities in a highly technological, global economy. As teachers we are obligated to help them obtain this second civil right — mathematical literacy. We are obligated to ensure that they, too, can stand before us to testify!

[about the author]

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CGI STUDENT ACHIEVEMENT IN REGION VI EVALUATION FINDINGS

[walter g. secada and jonathan l. brendefur]

IMPLEMENTING A PROFESSIONAL DEVELOPMENT PROGRAM WITH A PROVEN TRACK RECORD PROVIDES SOME ASSURANCE THAT STUDENT ACHIEVEMENT IN MATHEMATICS WILL IMPROVE. FOR EXAMPLE, VILLASENOR AND KEPNER (1993) FOUND THAT URBAN FIRST GRADERS WHOSE TWELVE TEACHERS HAD RECEIVED PROFESSIONAL DEVELOPMENT BASED ON COGNITIVELY GUIDED INSTRUCTION (CGI) OUTPERFORMED A MATCHED GROUP OF STUDENTS WHOSE TEACHERS HAD NOT PARTICIPATED IN THE SAME PROFESSIONAL DEVELOPMENT. ANALYSIS OF COVARIANCE REVEALED THAT, ON AVERAGE, CGI STUDENTS OUTPERFORMED COMPARISON STUDENTS BY: (A) 3 STANDARD DEVIATIONS ON NUMBER FACTS, (B) 4.11 STANDARD DEVIATIONS WHEN SOLVING WORD PROBLEMS IN ONE-TO-ONE (TEACHER-TO-STUDENT) INTERVIEWS, AND (C) 6.63 STANDARD DEVIATIONS WHEN SOLVING WRITTEN WORD PROBLEMS. THESE RESULTS ARE ASTOUNDING, RECALLING THAT A DIFFERENCE OF ONE HALF OF ONE STANDARD DEVIATION IS CONSIDERED LARGE. (SEE STATISTICAL NOTE NEXT PAGE.)

Findings such as these, however, cannot replace the need to carefully monitor the implementation of a program and the actual achievement of students in that program, which is what Comprehensive Center – Region VI did. More than 110 teachers have participated in the Comprehensive Center-sponsored CGI Institutes that provided initial professional development on the teaching of mathematics to at-risk students. The Center invited these teachers to participate in an evaluation of the program in their classrooms. Participation in the evaluation was completely voluntary and did not affect teachers' participation in any of the CGI Institutes nor their receiving follow-up support.

Cooperating Teachers

Over the course of two years, 63 first-grade teachers (34 CGI, 29 non-CGI), 48 second-grade teachers (24 CGI, 24 non-CGI), and 31 third-grade teachers (17 CGI, 14 non-CGI) participated in the evaluation. Of the 110 CGI teachers involved in the first two years' CGI Institutes, 75 participated, at some point, in the evaluation. The evaluation teachers came from throughout Region VI, with most teaching in the region's urban, small urban, and rural districts. CGI teachers invited same-grade, non-CGI colleagues who were teaching right next door to participate in the evaluation, thereby creating a matched comparison group.

This method mitigates against finding very strong positive treatment effects since the non-CGI teachers — as they visited their colleagues' classrooms and observed what the CGI teachers and their students were doing — eventually started teaching like the CGI teachers. (See Dearborn, Michigan — A System Changes, in this newsletter.) Interestingly, non-CGI teachers asked to participate in the CGI Institutes so that, at present, almost all of the comparison teachers have become CGI teachers.

Students

Assuming an average class size of 25 students, CGI teachers have taught more than 4,000 students during the first two years of CC – VI involvement offering CGI Institutes and followup services. Over the two-year course of this evaluation, the Comprehensive Center gathered mathematics achievement data on 986 first graders, 741second graders, and 365 third graders. Complete fall and spring achievement data are available for a smaller sample of students consisting of 745 first graders (423 CGI, 322 non-CGI), 514 second graders (303 CGI, 211 non-CGI), and 324 third graders (186 CGI, 138 non-CGI). The population of students includes poor Caucasian children, African American children, American Indian children, Hispanic children, Southeast Asian children, Arabic children, and children learning English as a second language.

Gathering and Analyzing Data

This evaluation used the written mathematics assessments which had been created for a longitudinal evaluation of CGI by its original developers (Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996). In the fall of each year, teachers administered the assessment for the previous grade and, in the spring, administered the assessment for that grade. For example, in the fall, first graders took the kindergarten assessment, then, in the spring, they took the first grade assessment.

Scales and Scoring

Teachers read the problems aloud, in English, to the entire class. If children had questions or did not understand something about the problem, teachers reread the problem.

- Assessment items were scored either correct or incorrect.
- The data analysis was based on the following scales.
- A student's score on each scale was the percentage of items answered correctly.

STATISTICAL NOTE:

Standard Deviations

Standard deviations are often used to describe differences between groups when the assessment instrument may be unfamiliar to the reader. This metric allows the reader to judge the difference between groups based on the spread of performance within groups. A difference of one half of one standard deviation is considered to be large since, in a normal distribution, approximately 68% of the scores fall within one standard deviation of the mean and about 95% of all scores fall within two standard deviations of the mean. By way of comparison, the SAT is normed so that a standard deviation is 100 points.

Effect Size

Effect size is computed by dividing the difference between the two groups' by the standard deviation of the comparison group. An effect size of .50, for example, indicates that the groups differed by one half of one standard deviation.

Finally, *p* is the probability that the difference between the two groups is a random difference. The smaller the value of *p*, the more likely the difference between groups is *not* due to chance — the more likely, in this case, it is due to learning mathematics in a CGI classroom.

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SCALES

1. Overall Performance
   (all assessment items)

WORD PROBLEMS

Successfully solving word problems for a given scale requires the stated mathematical understandings/skills. Examples of problems on each scale follow in the presentation of results.

2. Simple Addition and Subtraction
3. Complex Addition and Subtraction
4. Multiplication and Division
5. Place Value

COMPUTATIONS

This scale measured basic computational skills. Items in this category were "naked" computations — computations devoid of context.

6. Multi-Digit Computations

NOTE: ASSESSMENT ITEMS MAY FIT INTO MORE THAN ONE SCALE FOR EXAMPLE, A PROBLEM MAY BE CLASSIFIED AS A COMPLEX ADDITION AND SUBTRACTION WORD PROBLEM (SCALE 3) AND AS A WORD PROBLEM REQUIRING PLACE VALUE KNOWLEDGE (SCALE 5). ON SUCH ITEMS, THE STUDENT'S SCORE DOES NOT COUNT MORE THAN ONCE IN THE OVERALL PERFORMANCE (SCALE 1).

RESULTS

Evaluation results are based on analysis of covariance in which the spring scores on overall performance and on all subscales are covaried on the fall scores on the corresponding scales. While such analysis tells an important part of the story, it is only part of the story. For that reason, we also present examples from the problems on which CGI and non-CGI differed.

ANALYSIS OF COVARIANCE — *FIRST* GRADE

Scale	CGI Students n=423		Non-CGI Students n=322		
	% CORRECT	STANDARD DEVIATION	%CORRECT	STANDARD DEVIATION	EFFECT SIZE
1. Overall Performance	46%	28	40%	26	.24 (p<.001)
WORD PROBLEM					
2. Simple Addition & Subtraction	60%	32	53%	32	.19 (p<.025)
3. Complex Addition & Subtraction	48%	36	41%	33	.21 (p<.013)
4. Multiplication & Division	43%	35	34%	34	.26 (p<.001)
5. Place Value	45%	34	39%	31	.20 (p<.001)
COMPUTATION					
6. Computation	15%	30	9%	23	.27 (p<.001)

FIRST GRADE

Percent Correct on Selected Items

WORD PROBLEMS

CGI students outperformed non-CGI students in all categories.

2. Simple Addition and Subtraction

Paco had 13 cookies. He ate 6 of them. How many cookies did Paco have left?

STUDENTS	PERCENT CORRECT
CGI	74%
Non-CGI	67%

Misha had 23 pennies. She spent 8 pennies on candy. How many pennies did Misha have left?

STUDENTS	PERCENT CORRECT
CGI	55%
Non-CGI	41%

3. Complex Addition and Subtraction These problems go beyond what is found in the conventional first grade mathematics curriculum.

Chris had 18 marbles. He bought 25 more marbles. How many marbles does Chris have altogether?

STUDENTS	PERCENT CORRECT
CGI	46%
Non-CGI	33%

John has 38 dollars. How many more dollars does he have to save to have 58 dollars?

STUDENTS	PERCENT CORRECT
CGI	41%
Non-CGI	30%

4. Multiplication and Division Word Problems
These problems are not part of the conventional first grade mathematics curriculum.

There are 24 children in Ms. Tate's class. The class was divided into 4 teams with the same number of children on each team. How many children were on each team?

STUDENTS	PERCENT CORRECT
CGI	36%
Non-CGI	20%

5. Place Value
Fay has 3 packages of gum. There are 6 pieces of gum in each package. How many pieces of gum does Fay have altogether?

STUDENTS	PERCENT CORRECT
CGI	53%
Non-CGI	42%

COMPUTATIONS

6. Computations
These multi digit computations also go beyond what is found in the conventional first grade curriculum.

239 + 564 =

STUDENTS	PERCENT CORRECT
CGI	13%
Non-CGI	1%

INTERPRETING EVALUATION RESULTS

The statistical and individual problem results paint a dual picture. On one hand, students taught using the CGI program outperformed non-CGI students across the board. Yet even on more difficult problems that are not taught in conventional first grade mathematics, non-CGI students showed a greater level of competence than is typically ascribed to first graders — especially to at-risk students.

ANALYSIS OF COVARIANCE — *SECOND* GRADE

Scale	CGI Students n=303		Non-CGI Students n=211		
	% CORRECT	STANDARD DEVIATION	%CORRECT	STANDARD DEVIATION	EFFECT SIZE
1. Overall Performance	59%	27	52%	28	.29 (p<.019)
WORD PROBLEM					
2. Simple Addition & Subtraction	80%	33	74%	35	.17 (not significant)
3. Complex Addition & Subtraction	66%	33	59%	34	.21 (p<.026)
4. Multiplication & Division	55%	34	43%	35	.34 (p<.031)
5. Place Value	52%	33	46%	33	.17 (not significant)
COMPUTATION					
6. Computation	15%	30	9%	23	.27 (p<.001)

SECOND GRADE

Percent Correct on Selected Items

WORD PROBLEMS

CGI students outperformed non-CGI students in all categories.

2. Simple Addition and Subtraction CGI and non-CGI students performed comparably well. These problems are typical of what is usually found in the second grade mathematics curriculum.

Chris had 28 marbles. He bought 35 more marbles. How many marbles does Chris have altogether?

STUDENTS	PERCENT CORRECT
CGI	80%
Non-CGI	70%

3. Complex Addition and Subtraction CGI students outperformed non-CGI students. These problems are not part of the conventional second grade mathematics curriculum.

Pat has 26 baseball cards. How many more baseball cards does Pat need to collect to have 51 baseball cards altogether?

STUDENTS	PERCENT CORRECT
CGI	56%
Non-CGI	46%

John has 238 dollars. How many more dollars does he have to save to have 258 dollars?

STUDENTS	PERCENT CORRECT
CGI	55%
Non-CGI	44%

4. Multiplication and Division Word Problems CGI students outperformed non-CGI students. These problems are not part of the conventional second grade mathematics curriculum.

There are 24 children in Ms. Tate's class. The class was divided into 4 teams with the same number of children on each team. How many children were on each team?

STUDENTS	PERCENT CORRECT
CGI	64%
Non-CGI	38%

NOTE: OF THE CGI STUDENTS, 36% COULD SOLVE THIS PROBLEM AT THE END OF FIRST GRADE. THIS SUGGESTS THAT CGI STUDENTS MIGHT BE ACCELERATED ONE FULL YEAR RELATIVE TO THEIR NON-CGI PEERS ON THE DEVELOPMENT OF MULTIPLICATION AND DIVISION CONCEPTS.

A worm can crawl 4 inches in a minute. How far can the worm crawl in 8 minutes?

STUDENTS	PERCENT CORRECT
CGI	42%
Non-CGI	25%

COMPUTATIONS

5. Computations
CGI and non-CGI students performed comparably well. These multi digit problems are typical of what is usually found in the conventional second grade mathematics curriculum.

239 + 564 =

STUDENTS	PERCENT CORRECT
CGI	50%
Non-CGI	46%

INTERPRETING EVALUATION RESULTS

The second grade statistical and individual problem results paint a complex picture. CGI students perform as well as non-CGI students on content that is taught in the conventional curriculum. On advanced and more demanding content, however, they outperformed their non-CGI peers and, in some cases, might be advanced by one year. It also bears noting that, even on more difficult problems that are not taught in conventional second grade mathematics, non-CGI students showed a greater level of competence than what is typically ascribed to second grade at-risk students.

ANALYSIS OF COVARIANCE — *THIRD* GRADE

Scale	CGI Students n=186		Non-CGI Students n=138		
	% CORRECT	STANDARD DEVIATION	%CORRECT	STANDARD DEVIATION	EFFECT SIZE
1. Overall Performance	70%	26	57%	27	.29 (p<.001)
WORD PROBLEM					
2. Simple Addition & Subtraction	83%	37	77%	42	.15 (not significant)
3. Complex Addition & Subtraction	73%	37	62%	37	.29 (p<.009)
4. Multiplication & Division	69%	31	52%	32	.53 (p<.001)
5. Place Value	67%	33	55%	33	.38 (p<.003)
COMPUTATION					
6. Computation	73%	34	69%	35	.11 (p<.001)

THIRD GRADE

Percent Correct on Selected Items

WORD PROBLEMS

On word problems requiring simple and addition and subtraction (Scale 2) and on naked computations (Scale 6), CGI and non-CGI third graders performed comparably well.

Problems in both of these categories are found in conventional third grade mathematics.

3. Complex Addition and Subtraction
CGI third graders outperformed their non-CGI peers.

Pat has 26 baseball cards. How many more baseball cards does Pat need to collect to have 51 baseball cards altogether?

STUDENTS	PERCENT CORRECT
CGI	70%
Non-CGI	59%

4. Multiplication and Division Word Problems CGI students outperformed their non-CGI peers. Problems like these become more prominent in the third grade mathematics curriculum.

A worm can crawl 4 inches in a minute. How far can a worm crawl in 8 minutes?

STUDENTS	PERCENT CORRECT
CGI	75%
Non-CGI	54%

Note: Of CGI second graders, 42% answered this problem correctly.

There are 52 children in the third grade. The third grade was divided into 4 teams with the same number of children on each team. How many children were on each team?

STUDENTS	PERCENT CORRECT
CGI	60%
Non-CGI	41%

Fay has 4 packages of gum. There are 13 pieces of gum in a package. How many pieces of gum does Fay have altogether?

Students	*Percent Correct*
CGI	77%
Non-CGI	61%

5. Place Value CGI students outperformed non-CGI students.

Misha has 238 dollars. How many more dollars does he have to save to have 258 dollars?

STUDENTS	PERCENT CORRECT
CGI	76%
Non-CGI	64%

INTERPRETING EVALUATION RESULTS

CGI students have no trouble keeping up with their peers on content that is found in the conventional third-grade curriculum. However, when solving problems involving content that is not conventionally taught during third grade — content that, in fact, goes beyond what is typically taught in third grade — CGI students outperformed their non-CGI peers. Moreover, in third grade that difference in performance reached one half (.5) of one standard deviation, the largest margin by which CGI students outperformed their non-CGI peers. This suggests that, in terms of student achievement, CGI may prove to have increasing benefits as grade level increases.

ADAPTING WORD PROBLEMS FOR ENGLISH LANGUAGE LEARNERS

[*walter g. secada*]

Children who are English Language Learners (ELL) can, and do, solve word problems. For example, in a study of first-grade Spanish-speaking ELL students, I found that performance on addition and subtraction word problems was only slightly less than had been found among English-proficient students (Secada, 1991). Ghaleb's (1992) study with a group of Arabic-speaking second graders had similar findings.

Teachers, however, are often unsure of how to work with ELL students in mathematics. With children who all speak the same language, teachers who have the expertise may translate word problems into the language of the children. With a class of students from multiple language groups, simplifying the language — *not the mathematics* — of the problems is helpful.

The following chart, adapted from Secada & Carey (1990), gives some examples. The first column gives the mathematical problem type as classified in CGI (Carpenter & Moser, 1983). The second column gives a CGI problem of each type. The third column gives the Spanish translation of each problem (Secada, 1991). Finally, the last column gives a semantically simplified English version of each problem.

For explanation of the problem types and for more in-depth information about English Language Learners and CGI mathematics, see the references listed below.

Problem Type	English	Spanish	Simplified
Separate, Result Unknown	Julie had 15 pencils, and she gave away 11 of them (pencils). How many pencils does Julie have now?	Julia teniá 15 lápices, y luego regaló 11 de ellos (los lápices). ¿Cuántos lápices tiene ahora Julia?	Julie had 15 pencils. She gave away 11. How many does she have now?
Part-Part-Whole, Whole Unknown	Thomas has 4 blue crayons and 9 red crayons. How many crayons does he (Thomas) have in all (altogether)?	Tomás tiene 4 crayolas de color azul, y 9 rojas. ¿Cuántas crayolas tiene Tomás en total?	Thomas has 4 blues and 9 reds. How many is that in all?
Compare, Difference Unknown	Anne has 11 crayons, and Michael has 15 crayons. How many more crayons does Michael have than Anne?	Ana tiene 11 crayolas, y Miguel tiene 15 (crayolas). ¿Cuántas crayolas más qua Ana tiene Miguel?	Anne has 11 crayons. Michael has 15. Who has more? How many more?
Join, Change Unknown	Paul has 9 balloons. How many more balloons should Paul get in order to have 14 balloons?	Pablo tiene 9 globos. ¿Cuántos globos más debe obtener Pablo para que tenga 14 (globos)?	Paul has 9 balloons. He wants to have 14. How many (more) does he need?
Part-Part-Whole, Part Unknown	Robert has 14 toy cars in all (altogether). Six (6) of them (his toy cars) are blue and the rest are red. How many of Robert's toy cars are red?	Roberto tiene un total de 14 carritos de juguete. Seis (6) de sus carritos son rojos, y el resto son azules. ¿Cuántos de los carritos son azules?	Robert has 14 cars in all. Six are red. The rest are blue. How many are blue?
Join, Start Unknown	Rose had some blocks. She got 5 more (blocks) and now Rose has 13 blocks. How many blocks did she start with?	Rosa teniá algunos bloques. Luego recibió 5 (bloques) más y ahora, Rosa tiene 13 bloques. ¿Cuántos bloques tuvo Rosa al principio?	Rose has some blocks. She got 5 more. Now, she has 13. How many did she start with?
Separate, Start Unknown	Cynthia had some candies. She gave away 6 candies, and now Cynthia has 9. How many candies did she have to start with?	Cindy teniá algunos dulces. Luego regaló 6 de los dulces y ahora tiene 9. ¿Cuántos dulces teniá Cindy al principio?	Cynthia has some candies. She gives away 6. Now she has 9. How many did she start with?

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[about the author]

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COGNITIVELY GUIDED INSTRUCTION & SYSTEMIC REFORM

NATIVE AMERICAN PEDAGOGY AND CGI

[judith e. hankes]

All six states served by the Comprehensive Center – Region VI have Native American populations. Some teachers of those students have attended CGI Institutes and have successfully implemented Cognitively Guided Instruction. Judith Hankes – herself Native American – actively promotes the use of CGI with Native American students because of the cultural compatibility of CGI principles and Native American pedagogy. She includes CGI in her classes for preservice teachers.

A Comparison of Pedagogical Principles	Dominant Culture Pedagogy	CGI Pedagogy	Native American Pedagogy
Role of Teacher	Teachers generally behave in a didactic manner, disseminating information to students.	Teachers generally behave in an interactive manner, mediating the environment for the student.	The facilitating teacher role promotes cooperative and autonomous learning. Conversational topics are not controlled by individual speakers.
Student to Student Interaction	Students primarily work alone.	Students frequently work in groups and are encouraged to reflect on and discuss their own and other's thinking.	Caretaking patterns of extended families and bonded community interactions are replicated in group learning experiences.
Curriculum	Curriculum activities rely heavily on textbooks and workbooks.	Curricular activities rely heavily on primary sources of data and manipulative materials.	Lessons relate to real problems that will likely confront the student.
Time	The day is partitioned into blocks of time and content coverage. Time on task is considered important.	Class time is spent solving complex problems. Students are encouraged to reflect on and discuss their own and other's thinking. This is often a time consuming process.	Instruction/learning is time-generous rather than time-driven. When an activity should begin is determined by when the activity that precedes it is completed.
Concept Formation	Concepts are presented part-to-whole with emphasis on basic skills.	Concepts are presented whole-to-part with emphasis on big ideas.	All knowledge is relational, presented whole-to-part not part-to-whole. Just as the circle produces harmony, holistic thinking promotes sense-making.
View of Learner	Students are viewed as blank slates onto which information is etched by the teacher.	Students are viewed as thinkers with emerging theories about the world. Students are believed to possess prior knowledge.	Each student possess Creator-given strengths and is born a thinker with a life mission.
Assessment	Student assessment is viewed as separate from teaching and occurs almost entirely through testing. Testing often stratifies students and promotes competition.	Assessment is interwoven with teaching and occurs through questioning and observation of student work. Each student is instructed at her/his appropriate learning level. There is little, if any, use for competition.	Age and ability determine task appropriateness. Learning mastery is demonstrated through performance. Creator ordained mission determines one's role in life, and no one mission is better than another. Competition, situating one as better than another is discouraged.

The chart above is adapted from Dr. Hankes' book: Hankes, Judith E. (1998). *Native American Pedagogy and Cognitive Based Mathematics Instruction*. New York: Garland Press.

[about the author]

JUDITH E. HANKES is Assistant Professor of Curriculum and Instruction, University of Wisconsin – Oshkosh.

A CGI Classroom Vignette

Assessment and instruction are closely entwined during CGI lessons. The following vignette depicts how a teacher might incorporate assessment into instruction and might make some decisions based on what she is learning about her students. By asking students to talk about their solution strategies, the teacher also gives them an opportunity to share ideas and to develop vocabulary for talking about word problems.

The teacher began her questioning by asking how students had solved the problem. At first, Penny and Sam did not fully understand the problem, so the teacher helped them focus on its various parts: what they wanted to know, and what they already knew (the story already told us that). Then, she simplified the problem by asking how many stickers would be needed to go from 8 stickers to 9 stickers. Penny caught on and extended her insight to the problem itself. Meanwhile, the teacher modeled what Penny was doing by posing a problem that was slightly beyond their reach. She helped them attend to the details of the problem, and then she allowed them to engage in discussion among themselves about the problem and its solution. All the while, the teacher was assessing what Sam and Penny understood about the problem. She used that knowledge to ask her next question or to point out the next fact.

In CGI classrooms, as students and teachers become more comfortable with CGI, the give and take becomes easier. To encourage student discussion, teachers can:

1. Point out disagreements and let students try to resolve them among themselves.
2. Summarize results and introduce language that supports further discussion. First grade students in one CGI class discovered that the sum of two odd numbers is an even number. This became a "theorem" that was invoked in class discussion a few days later.
3. Ask, "Did anyone do this a different way?" One CGI teacher encourages her students to come up with as many different ways as they can to solve a given problem.
4. Allow students who are working together to solve a problem or to resolve a disagreement to go off and work without interruption. Have the students present their results when they are finished. This may itself engender further class discussion.

Students in some classrooms have helped write problems. Since first-grade students like large numbers, some of their problems reflected that. Not surprisingly, they were motivated to invent ways of solving their own problems. Thus, many first grade students had invented algorithms for doing multi-digit addition before the end of their first semester in school.

CGI teachers have used whole-class settings. They have sent groups of students to work at problem centers. They have assigned individualized problem sets to students. Throughout, however, the focus has been on problems that challenge students and on students' discussion of their solutions.

REPRINTED FROM:

Secada, W. G. & Carey, D. A. (1990). *Teaching mathematics with understanding to limited English proficient students* (Urban Diversity Series No. 101, pp. 41-44). New York City: ERIC Clearinghouse on Urban Education, Institute on Urban and Minority Education. Teachers College, Columbia University. [Available through ERIC; also available as a PDF file at http://www.wcer.wisc.edu/ccvi/cgispider/articles/AboutCGI.asp].

Teacher: *Nina had 8 stickers. She bought some more stickers. Now she has 12 stickers altogether. How many stickers did she buy?*

Penny: 12. [Penny has one group of 12 chips on her desk.]

Sam: *That's what I got.* [Sam also has one group of 12 on his desk.]

Teacher: *Penny, tell us how you figured that out.*

Penny: *Well, first she had 8, so I counted 8 of these* [chips]. *Then she got some more and now she has 12. She got 12* [pointing to the whole group of chips].

Teacher: *Yes, she has 12 stickers altogether but the story already told us that. Let's listen again.* [The teacher reads the story again.] *Penny, what is the story asking us to find out?*

Penny: *How many she bought.*

Teacher: *How many stickers did Nina have to begin with?*

Penny: 8.

Teacher: *First you said you counted out 8. Where is your group of 8?*

Sam: [Makes a group of 8 chips.] *Here's 8.*

Teacher: *Penny, you show me a group of 8, too.* [The teacher models what Penny is doing by making a set of 8 on the overhead projector so the rest of the students can see Penny's modeling.] *Is that how many she had altogether?*

Penny: *No, she needs some more.*

Teacher: *Sam, how many more would she need to have 9 stickers altogether?*

Sam: [Adds 1 more chip, hesitates, then begins to count them all.]

Teacher: *Sam, Nina had 8 stickers.* [The teacher points to the set of 8, then points to a separate set of 1 that was added on.] *How many more did I add so that she could have 9* [pointing to the set of 1 chip]?

Sam: *1?*

Penny: *It's 1. 8, 9.* [Penny adds another chip.]

Teacher: *How did you know that?*

Penny: *I just added on 1 more to 8 and got 9.*

Teacher: *Nina had 8 stickers to begin with, how many more would you add on to make 12?* [The teacher reconstructs the set of 8 chips on the overhead.]

Penny: *Oh* [Penny whispers the counting sequence "9,10, 11, 12," keeping the second set separate from the set of 8, then counts the set she added on], *4.*

Teacher: *How many more stickers did Nina buy?*

Penny: *4.*

Teacher: *Ok, let's try another problem.* [The teacher gives the children a similar problem and focuses on Sam.] *Pat had 7 shells in her bucket. Her brother gave her some more shells. Now Pat has 10 shells in her bucket. How many shells did her brother give her?*

Sam: *10.*

Penny: *No, it's 3. See, 8, 9, 10* [pointing to a group of 3 chips on her desk].

CGI and CC – VI Services

Practicing Cognitively Guided Instruction (CGI) means basing one's teaching and instructional decisions on student thinking.

In this professional development program, teachers are introduced to research-based information about students' thinking as they solve word problems. Teachers learn to categorize word problems according to the *mathematical* demands of the problems and to understand students' solution strategies in terms of the cognitive maturity of those strategies. Teachers see video tapes and analyze actual student work. This knowledge of student thinking is, as Professor Fennema emphasized, "powerful information," and, having it, teachers do change the way they teach. The emphasis of CGI, however, is on students' *mathematical* thinking and problem solving strategies and on the *mathematical* demands of the word problems, *not* on teaching behaviors or ready-to-use curriculum.

CGI Institute

The Comprehensive Center offers an annual week-long CGI Institute for teachers to learn about CGI. In general, CC–VI asks districts or schools to send teams consisting of two to three teachers and one specialist (the mathematics coordinator, Title I coordinator, or principal, for example). This encourages ongoing, broad-based support once teachers are back in their schools implementing CGI. Teachers can share instructional strategies or observe each other's lessons, for example. Specialists can assist teaching, observe, or help in other ways that undergird teachers' efforts. CC–VI also asks each team to submit a letter from their principal pledging to support the teachers' use of CGI in their classrooms. Without outright principal consent any reformed, practice can easily be thwarted.

Advanced CGI Institute

The Center also offers an annual week-long Advanced CGI Institute for those who have attended a CGI Institute and have implemented CGI for at least one school year. Participants engage in discussions of deeper issues of CGI and develop deeper understanding of student thinking and problem-solving strategies. Teachers also learn how to lead CGI workshops or institutes in their own district.

Ongoing Services

Because CGI focuses on students' responses and on understanding their thinking as the basis for instructional decisions, it is, at times, a difficult and uncertain endeavor for the teacher in the classroom. So, even when teachers leave the Institute with increased enthusiasm for teaching mathematics, they do not always implement CGI without added support. To address this, CC-VI provides ongoing services for schools and teachers implementing CGI.

1) *Fielding phone calls and e-mails*
   Teachers can ask questions about CGI and get responses quickly.
2) *Maintaining a web site* — www.wcer.wisc.edu/ccvi/cgispider/
   Here teachers can find newsletters and research articles about CGI and related topics with web links to other pertinent sites. This site also contains information about upcoming CGI Institutes, stories from past CGI participants, articles about elementary schools currently implementing CGI as well as web links to those schools' web sites, a web board and chat room for ongoing and real-time conversation about CGI, and information about related institutes and conferences.
3) *Site visits by CC–VI Specialists*
   Specialists can observe, team teach, or teach in the classrooms. They hold workshops and/or discussion sessions after school with CGI teachers, and other teachers who are interested in CGI are welcome to attend. These site visits are tailored to the needs and desires of the teachers and the school with the specific purpose of supporting the implementation of CGI.

Suggested Reading

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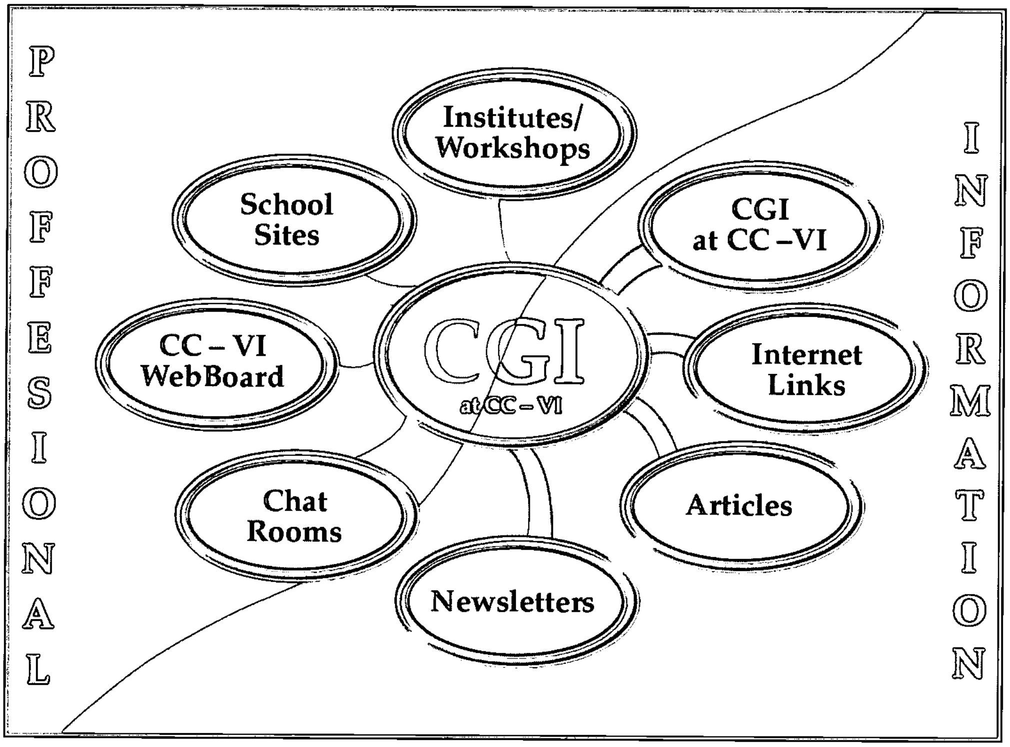
Find It on the Web!

Look for the CGI Spider GoTo www.wcer.wisc.edu/ccvi/cgispider/



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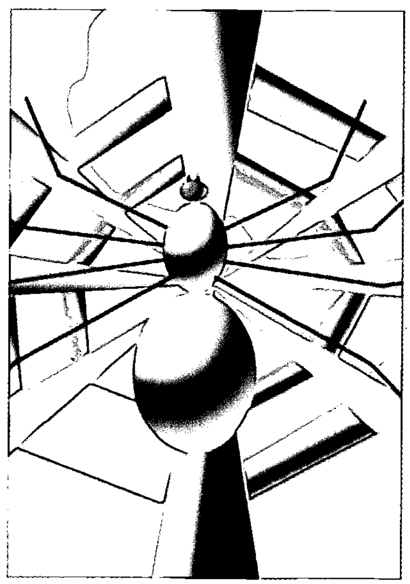
Paricipation limited to forty teams consisting of one mathemetics/professional development specialist and three or four K-3 teachers.



FARGO, NORTH DAKOTA — A STORY OF TEACHER CHANGE

[*jonathan l. brendefur and sherian e. foster*]

AT A GLANCE, FARGO MIGHT APPEAR TO BE A QUIET MIDWESTERN CITY OF 80,000 WITH A RICH SCANDINAVIAN HERITAGE. ALTHOUGH THIS WAS, PERHAPS, TRUE JUST A DECADE AGO, FARGO HAS BECOME A SAFE HAVEN FOR BOSNIANS, SERBIANS, CROATIANS, ALBANIANS, MACEDONIANS AND OTHERS. AN ELEMENTARY TEACHER MAY NOW HAVE, IN ONE CLASSROOM, AS MANY AS FIVE CHILDREN WHO ALL SPEAK DIFFERENT LANGUAGES. ONE TEACHER SAID THAT 40% OF HER STUDENTS ARE ENGLISH LANGUAGE LEARNERS. FINDING TRANSLATORS FOR THE NUMEROUS LANGUAGES IS NEARLY — IF NOT COMPLETELY — IMPOSSIBLE. FARGO IS NOT WITHOUT SOCIO-ECONOMIC PROBLEMS; UP TO 80% OF STUDENTS QUALIFY FOR FREE OR REDUCED LUNCH. TEACHERS NOW PRAISE CGI, NOT ONLY FOR HELPING INCREASE ALL THEIR STUDENTS' UNDERSTANDING OF MATHEMATICS, BUT ALSO FOR HELPING THEM BECOME MORE VERBAL AND ARTICULATE IN ENGLISH.

What happened? How was CGI part of teacher change in Fargo? It began in 1998 when a team of three veteran teachers — teachers with a long history of teaching by using lecture, textbooks, and worksheets — attended the CGI Institute in Madison, Wisconsin. In spite of this, and in spite of other teachers and some administrators, they slowly began to change their practice and to affect colleagues around them.

"Well, I haven't had a chance to work with the team at all. There were only three of us. [One of us] is at another school. I have seen her twice. And I don't even know if she has gotten into CGI. I chose to start CGI right away, and [the other teacher], I believe, maintained her traditional procedure of teaching math until after Christmas."

Instructional changes, as we know, are difficult. At face value, the implementation of CGI in Fargo that first year may appear unsuccessful, since only one of the three teachers used it regularly in her classroom. On the other hand, even though all the teachers did not incorporate CGI every day, *all three* teachers *did use* CGI to varying degrees.

Teaching by CGI principles, even a few days a week, had a dramatic impact on these teachers, and that success spilled over onto neighboring teachers. For example, one teacher told how she would describe to her colleagues changes in her students' attitudes and knowledge while learning "CGI mathematics." The next four teams (twelve teachers) from Fargo attended the second CGI Institute. This time, the teams comprised teachers from the same grade level from the same elementary schools. During the following school year, the teams did, in fact, meet regularly (at least once a month) to discuss CGI problems, look at student work, and share how they were applying what they learned from the Institute. As confirmed, teachers' practices were noticably different. By an insurgence of energy from other teachers, along with the support of the monthly CGI meetings, teachers were implementing CGI three, four, and five times a week. Implementation of CGI was much more successful and widespread that year.

AWARENESS OF STUDENTS

Just how did teachers change? Five teachers were interviewed at the 2000 Advanced CGI Workshop. All were emphatic in saying that, by focusing on understanding student thinking, they were astounded at what their students knew and could do. One third-grade teacher talked about how her students used place value knowledge and invented strategies that "I wouldn't even have thought they could use. And they did!" A first-grade teacher said she asked her students, "If we had 15 spiders, and each spider has eight legs, how many legs do we have?" She continued, "And a little boy knew exactly what it was. It was no problem. And he wasn't the only one!"

A first-grade teacher marveled at the knowledge students bring into the classroom with them. She said, "Most of us wouldn't have dreamt, in our traditional way of thinking of math, of starting multiplication and division in kindergarten and first grade!" CGI, she said, had shown her "that children can do this," and emphasized that "we are actually looking at children coming in with kinds of knowledge [we never expected]."

Teachers also reported seeing changes in students. One teacher told about two specific first graders. She had a boy, who, at the beginning of the year, "could manipulate numbers; he could do long division, multiplication; he knew place value; he knew everything there was." The CGI problems, she said, helped him to model and understand his own thinking, and he "in a way, taught the other students to manipulate numbers." For example, he might say, "I know that 12 is 10 and 2 ones," or, "If I have 7 and take 3 from another number, then I have 10." In contrast, this teacher had another student with "severe language delays" who watched students model and explain problems. "Over the course of the year," she said, "he was able to explain problems too," and he has had no difficulty doing so.

Teachers said, too, that they saw students develop a "much better attitude regarding math" and that students "really, really had fun working together and hearing each other's strategies." They truly enjoy taking problems home and come back saying, "Look, I thought of *three* CGI problems last night!"

CHANGES IN TEACHER ROLE AND PRACTICE

By focusing on student thinking, teachers became facilitators instead of knowledge givers. One teacher said, "I don't even consider it teaching actually, because they are teaching one another." Another added, "You're just monitoring." Still another said, "You're just the coach." These statements should not lead us to trivialize the new role CGI teachers play and the demands placed upon them. As one teacher pointed out, they are constantly "analyzing students' strategies and deciding what to give them next." She added that the teacher must "be careful diagnostically [and know] exactly where the child is." That means knowing where *every* child is and what problem *each* child should be given next.

One teacher contrasted this with her previous role as a giver and tester of knowledge. Before, she said, if students got 97% on a math test everyone was happy, "even though I might be totally missing the fact that they're not counting by tens; they don't have a clue whatsoever what they're doing; they can only do this by rote." Now, she added, "I take it apart in so many ways" to analyze what the student can and cannot do and to decide what to try next.

A third-grade teacher said, "I was a pretty textbook person. . . . I was just religious about looking at that teacher's edition [and following it exactly]. . . and not even watching the kids necessarily." Then, in the interview, followed this rapid-fire conversation:

A "I sometimes still felt like, if I wanted them to add, I had to teach them *how* to add, *how* to join, *how* to separate."

B "Before, we took the manipulatives and showed them how to use those. How to manipulate the manipulatives! We can't just let them take them and . . ."

A "I had to model *everything*. 'Oh, those students, they don't know anything.'"

B "And my mouth dropped open, and I realized they *did know*, and I didn't have to teach them."

IMPACT ON OTHER SUBJECT AREAS

Although all teachers reported using CGI tenets and principles in other subject areas, the teachers of Reading Recovery and of English Language Learners (ELL) were most emphatic on this point. A third-grade teacher said that using CGI "really demands that children work together and do a lot of dialoging and sharing. . . . It's really rich in language usage. If you use CGI, children are listening, speaking, reading, and — another important aspect — *writing* their own problems." One teacher said, "I adapted CGI problems directly to my reading and phonics program." She said children were excited when they found their sight words in the word problems and then, because they could read the problems, were able to solve them.

Another teacher reported that she adjusts the language of the problems, not only to make it possible for students to solve them, but also to teach English. Instead of a problem about cookies, for example, she transforms it to a problem about cubes. The manipulatives, then, are the objects in the problem, not *representatives* of something else. Students and teacher can then easily act problems out and, eventually, read them.

Teachers said they saw students develop a "much better attitude regarding math" and that students "really, really had fun working together and hearing each other's strategies." They truly enjoy taking problems home and come back saying, "Look, I thought of three CGI problems last night!"

USING CC – VI SERVICES

Teachers said that the Institutes and other Comprehensive Center services have been invaluable. The Institutes and on-site workshops are particularly helpful, because, one teacher said, "They are modeling what we need to do with our own children by letting us discuss it and try to figure it out ourselves. They are not going to tell us the answer. They want us to find the answer on our own just like the philosophy of CGI." That helps her in the classroom, she said, because it reminds her to let her students "do it on their own."

Another teacher talked about a discussion in one of their monthly meetings with Jonathan Brendefur from the Center. He posed the question, "What do you do with a child who makes a mistake?" She said, "and a two hour discussion followed!" This was "so much more beneficial," the teacher said, than being told how to teach "6 plus 7."

In fact, during the second year of CGI implementation, the Fargo teachers eagerly utilized CC-VI support services. They asked Jonathan Brendefur to visit their schools and team teach with seven of their CGI teachers. In each class he used the *teacher's* lesson to focus on one of the following points — mathematical errors, expanding the problem, encouraging students to use multiple or more advanced strategies, examining *mathematical* differences in strategies (versus superficial differences).

Each of these ideas is important in supporting students' understanding of the mathematics, and they are somewhat difficult to implement — perhaps because they have not typically been a focus in traditional mathematics instruction.

Brendefur explains: For example, in Ms. Davis' class, we focused on the mathematical differences among students' strategies. She gave her first graders the following problem:

(continued on next page . . .)

FIRST GRADE PROBLEM

Rachel had 17 toy cars. She gave 11 of them away. How many toy cars does she have now?

While some students used cubes to model the problem, most worked on hand-held white boards. After students had time to work on the problem individually, I first asked Madeline to share her strategy with the class.

MADELINE'S STRATEGY

Madeline explained that she had counted out 17 toy cars. She had not used actual toys or manipulatives. On her white board she had written the following numbers:

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

She then crossed off, starting with the seventeen, eleven of the numbers.

1, 2, 3, 4, 5, 6, ~~7~~, ~~8~~, ~~9~~, ~~10~~, ~~11~~, ~~12~~, ~~13~~, ~~14~~, ~~15~~, ~~16~~, ~~17~~

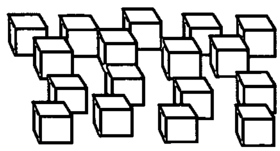
Next, Madeline counted the remaining numbers, by 1, to get to 6. She ended by using the following notation:

17 – 11 = 6.

Next I asked the class, "Did anyone solve it differently than Madeline?" Toby raised his hand, and I asked him to explain. Toby used the following strategy:

TOBY'S STRATEGY

Toby used cubes to show there were 17 toy cars.



Then he physically removed 11 of them and counted the six remaining.

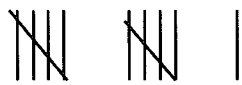
I asked Toby to share the notation he used for the problem. He showed the class his white board, which had on it:

17 – 11 = 6

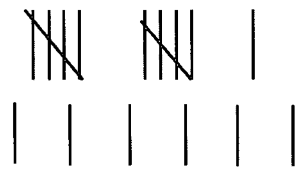
At this point, I asked Samantha to share her strategy.

SAMANTHA'S STRATEGY

Samantha told how she made 11 tally marks to represent the number of toys Rachel had given away.



Then, underneath these marks she made another set of tally marks, counting 12, 13, 14, 15, 16, 17.



She then went back and counted the number of tally marks in the second row and found it to be six.

Samantha made the following notation:

11 + 6 = 17.

In class, we used the next few minutes to discuss the similarities and differences between these strategies. The students said that the two strategies were dissimilar in that Toby used cubes but Madeline used numbers on the white board to solve the problem. They came to an agreement, however, that the mathematics in the two strategies was similar.

We spent some time discussing whether Samantha's notation was correct for how she thought about the problem. Students concluded that it was.

I then asked students to work in pairs and decide whether their strategies were similar to Madeline's, Toby's, or Samantha's and to find other students with these strategies. This activity took about ten minutes and led to some good mathematical conversations.

For example, in the groups, students had decided that the following number strategy was mathematically similar to Madeline and Toby's strategy:

10 from 17 is 7, and 1 more is 6

They also decided that the following strategy was mathematically similar to Samantha's:

11 plus 5 is 16, so 11 plus 6 is 17.

During one of their monthly meetings, Ms. Davis shared her students' work and ideas. Other CGI teachers brainstormed ways to involve students in taking ownership of their strategies and ways for students to understand how strategies are mathematically different. At the end of the meeting, two teachers distributed some problems that they wanted the rest of the teachers to try in their classrooms. They would then focus the next CGI meeting, not only on how students solved these problems, but on how each teacher adapted the problem for students who solved it easily and for those who had difficulties.

CHALLENGES TO FACE

Finding and sharing with colleagues is essential. As one teacher said of the monthly meetings, "That's what kept us all going."Another said, "I am in a building with twenty-nine teachers, and I am the only one who does CGI. . . . They are interested in it, but they can't really share my experiences." Thus, there is need, not only for CGI teachers to learn more, but to share and spread CGI. One teacher said, "I think the five of us are making a leap of faith by coming here to the Advanced Institute and saying, 'O.K., we're going to have to go back and facilitate this information to our colleagues.'" She added that they knew it would be a struggle," because it's not a matter of sharing a three-hour workshop."

All agreed that dealing with colleagues who are not CGI teachers, or who know little about it, is the big challenge. One teacher said, "I'm on the Scope and Sequence Committee for the standards and benchmarks for Fargo Public schools, and, let me tell you, they think I'm from outer space!" This is because, she said, they have so little understanding of what mathematics children are capable of doing. Other colleagues, teachers said, think CGI is "only for teaching story problems," that there are still "things that aren't covered" — measurement, for example.

Some colleagues don't see the need for word problems at all. One teacher told of attending an in-service on thinking strategies, "where it's the direct opposite of CGI," she added. When she asked about doing story problems and insisted that was important, "the other teachers said, 'Oh, no. Don't be silly. No, you don't [have to do story problems].'"

In spite of these challenges, and more, CGI teachers are committed to learning more and moving ahead. Why? Because of the students. Because of the "amazing" mathematics they see students doing and the joy with which they do it. Reform in classroom instruction is a long, arduous process.It takes dedication and support. But, Fargo has begun the formidable process of such reform. They sent an additional ten teachers to the third summer CGI Institute, increasing the number of teachers participating in the CGI Institutes to more than twenty-five. Five of these teachers have attended an Advanced CGI Institute. Fargo teachers will continue to grow and change. CC

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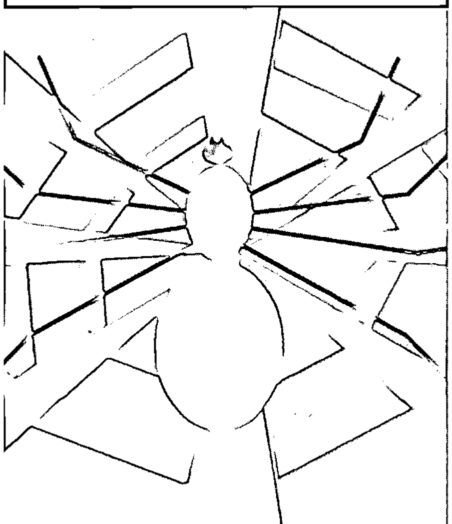


DEARBORN, MICHIGAN — A SYSTEM CHANGES

[*jonathan l. brendefur and sherian e. foster*]

DEARBORN, MICHAGAN—IN CONTRAST TO FARGO—IS A CITY OF 150,000 WHICH IS PART OF THE DETROIT METROPOLIS. DEARBORN, IS THE BIRTHPLACE OF HENRY FORD, THE CAR-MAKING GIANT, AND HAS ONE OF THE LARGEST ARABIC-SPEAKING POPULATIONS IN THE UNITED STATES. ABOUT 35% OF THE DEARBORN PUBLIC SCHOOL STUDENTS ARE ENGLISH LANGUAGE LEARNERS (ELL). HOWEVER, WITHIN THE FIVE MAIN ELEMENTARY SCHOOLS THAT ARE IMPLEMENTING CGI, THE ARABIC POPULATION IS ABOUT 90%.

Dearborn is a compelling example of how a new species of instructional tenets and practices — CGI — entered, took root, and spread within a school district ecosystem. Dr. Wageh Saad and Judy Dawson, Dearborn Public Schools (DPS) administrators, deliberately chose CGI to orchestrate a change in instructional practices in mathematics that would be both substantive and generative. They chose CGI because it is research-based and has a long history of effecting positive outcomes in students' mathematical knowledge and skills.

To seed CGI in the district and to sustain the changes they anticipated, DPS implemented a three-part plan. First, Saad and Dawson sent five teams (a total of seventeen people) to the 1998 CGI Institute. Second, beginning in the 1998-1999 school year, to create a nurturing environment in the schools, DPS established monthly meetings for the teachers who had attended the CGI Institute so they could share successes and discuss students' solutions to problems. Third, in the summer of 1999, they sent a group of these teachers to the Advanced CGI Institute.

In the summer of 2000, after implementing CGI for two years, DPS sent another set of CGI teachers to the Advanced CGI Institute as well a new set of teachers, not yet formally introduced to CGI, to the CGI Institute. This further nurtured and spread CGI principles and practices throughout the Dearborn elementary schools. Currently, in the 2000-2001 school year, the number of teachers who have attended a CGI Institute has tripled, and a third of those teachers have attended an Advanced CGI Institute. Now, with this broad base of teachers, specialists and administrators with formal knowledge of — and experience using — CGI, DPS is ready to offer its own CGI Institute in the Dearborn School District.

HOW DID THIS HAPPEN?

Four teachers were interviewed at the 2000 Advanced CGI Institute, and they affirmed that many teachers were accustomed to using the textbook and/or worksheets as the mainstay of their instruction. One teacher said, "The textbook has limited us. . . . It's done so inefficiently!" Another said, "We've pretty much realigned the entire way we teach math. The textbook isn't used in my classroom! I use it only for a substitute to have something to do." Yet another teacher said that, previously, she had really never assessed her students except by giving textbook tests.

However, even after the original seventeen teachers were charged to change their math instruction — and were excited about it after attending the beginning CGI Institute — they still had to return to the then-existing school environment and attempt to teach math in a new, even radical, way. Three implementation patterns occurred: 1) Some teachers began using CGI as the dominant means of math instruction. 2) Some teachers supplemented CGI with a little traditional instruction. 3) Some opted to return to their traditional ways of teaching math and implemented CGI, at the most, once a week.

DISTRICT SUPPORT

As teachers implemented CGI, uncertainty emerged, and teachers were faced with making difficult instructional decisions. To create a nurturing environment and assist the teachers in such situations of uncertainty, there DPS maintained three supports.

First, because teachers had attended the CGI Institute in teams, they could walk down the hall and ask each other for assistance or share successes. One first-grade teacher, for example, said she had been skeptical "even after watching the tapes [of CGI students]. . . . Multiplication and division? Do they know *my* kids?" Then she began implementing CGI across the hall from another CGI teacher. Her first graders would solve a multiplication or division word problem, and, she said, "I'd be so excited. I'd say, 'Go tell Miss T. I don't care what she's doing over there! Just disturb her!'" Later they could discuss students' strategies and reasoning. Teachers said they did "some teaming and were a sounding board for each other."

Second, the monthly meetings, set up by DPS for CGI teachers, gave them opportunities to share success stories, write problems for all to use, and generally assist each other as needed. All teachers interviewed affirmed the importance of these meetings. One said they "spend two or three hours sharing" and that they were "so excited to share what we started to see [in students]."

Third, to encourage CGI to grow and spread, the Center sent a specialist to DPS twice during each school years to fertilize, tend, and prune the emerging CGI practices. On these follow-up visits, staff services included observing classes and giving teachers feedback, team-teaching with CGI teachers, offering workshops, meeting with teachers, and facilitating discussions. Teachers used these services to varying degrees.

PROFESSIONAL TEACHERS

CGI also spread through the professionalism and sharing of teachers. One teacher said, "I observed a classroom of one of the teachers who went [to the CGI Institute] the first year, and it was just unbelievable! I just couldn't believe the types of problems the students were solving successfully and the strategies they were coming up with. And when I saw that, it really was an incentive for me to come [to an Institute]." Another said she "had heard from a couple of other teachers how useful CGI was and how it really worked for the kids. They got me excited, and so I wanted to come." Still another said the resource teachers "felt we would like to teach the content with more understanding, rather than memorization." They heard about CGI from other teachers and wanted to attend the Institute.

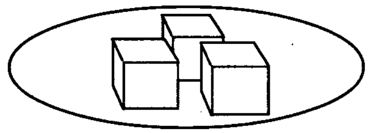
Teachers' professionalism directly affected non-CGI teachers and kept principals involved and informed. One teacher reported, "One of our traditional teachers — who does still use the workbooks and things, because that's all she knows — has come in and observed [two of us] to try and learn more about what CGI is."

A second grade teacher excitedly told this story. "I took kids to our Assistant Principal, and said, 'You have to hear this!' And she specifically saw them adding two and three four-digit numbers [e.g., 327 + 484] very quickly. Faster than she could add it! They gave her an answer, and she was saying, 'Wait a minute.' She was still figuring it out. It was amazing."

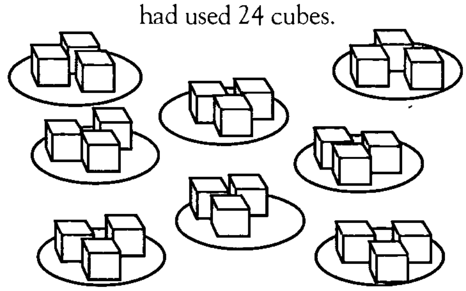
Throughout the first year of implementation (1998-1999), CGI teachers shared in great depth with other teachers the types of problems their students were solving and how students explained their strategies. For example, one teacher told how her second graders solved the following problem:

There were 24 students taking a field trip. Each seat in the bus could hold up to 3 students. No student could sit alone. What are two different ways students can sit on the bus?

One student drew an oval on her paper then placed 3 cubes in the oval.



She repeated this until she had used 24 cubes.



Finally, she went back and counted the ovals (seats) and found that she had 24 students in 8 seats.

Another student put tally marks in circles to represent students in the bus seats, but she found that 24 students could sit in 12 seats if they sat in pairs.

Students found various other solutions with some children sitting three to a seat and some sitting two to a seat. Some students used number facts they knew and did not draw a picture to solve the problem.

Immediate expansion of CGI took place as many teachers tried such problems in their own classrooms and were amazed at what their students did. By the end of the school year, another group of teachers from these first five elementary schools was eager to attend the next CGI Institute — doubling, at that time, the number of teachers with formal knowledge about CGI.

Five CGI teachers, one elementary principal, and one resource teacher (all of whom had attended a CGI Institute and spent a year implementing it) attended the Advanced CGI Institute in the summer of 1999. These teachers, more confident in their knowledge of CGI, went back to Dearborn with an expanded role. They fertilized, tended, and pruned by discussing CGI formally at the monthly CGI meetings and by presenting CGI ideas at district in-services, and they sowed seeds beyond the district by presenting talks about CGI at conferences.

ADMINISTRATIVE SUPPORT

Teachers emphasized that they struggle and are growing all the time. They also stated strongly that the week-long CGI Institute is vital. Some had attended shorter workshops, but, as one teacher said, "I didn't get a complete idea of [CGI]." She said she then tried to use CGI from time to time and "thought I was doing fine until I came here and had the full five days!" Another teacher went further, saying that even the beginning CGI Institute "wasn't enough for a person to really learn enough." She added that "the beauty of the whole thing is using it for a whole year then coming back [to ask questions and learn more]." Others affirmed this but reiterated that the follow-up supports mentioned above are also essential for CGI to survive and grow.

Support from the principal and district are essential to implementing and sustaining the use of CGI, teachers said. "With support from the principal, we use CGI," said one teacher. Another chimed in, "Support from the principal, that's exactly it. She really believes in CGI." The teachers interviewed felt that there was support by district administrators — citing the planned district CGI Institute — but still think high-level administrators and school board people need to understand CGI better, possibly even attend an Institute.

(continued on page 23...)

THE COMPREHENSIVE CENTER–REGION VI

The mission of the Centers, under the Improving America's School Act (IASA), is to empower school personnel to improve teaching and learning for all children. The technical assistance provided by the Comprehensive Centers is driven by the needs of the states and local school districts and by the needs of the children they serve. The Comprehensive Center–Region VI serves Iowa, Michigan, Minnesota, North Dakota, South Dakota, and Wisconsin.

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FROM THE DIRECTOR

[continued from page 24]

Challenge 4

CC-VI services should eventually impact the entire school system, not just individual schools.

We already know that *all* children can learn. Also, we already know that some schools can be very successful at helping all children to learn. The CC-VI set for itself a higher standard than simply showing that it is possible for *some* schools to help *all* their children learn — including students eligible for Title I and English Language Learners. Rather than demonstrate change, we wanted to *seed* change.

The Comprehensive Center – Region VI purposefully created its CGI Institutes so that teachers would have a year to try out the ideas and refine their teaching of their own children. Teachers left our Institutes enthusiastic about the new ideas they had learned and brimming with teaching ideas to try out. We correctly assumed — as documented by the evaluation — that other teachers would become curious about what their colleagues were doing. Indeed, other teachers began to request — and, in some cases, to demand — access to the same Institute and to the ideas that their colleagues had acquired. This curiosity, the original teachers' enthusiasm and success, and the powerful ideas that were shared among teachers nurtured the soil in which the seeds of change germinated, blossomed, and spread.

To further support systemic change, the Center recruited Institute participants to become presenters and full partners at later CGI Institutes which were attended by many of their colleagues. Some districts are developing their own CGI Institutes for all teachers. And, as documented by the CC-VI evaluation, districts have begun to put in place policies that institutionalize these changed practices.

Challenge 5

CC-VI services should include a delivery system that can expand the Center's reach.

No Comprehensive Center has the human or financial resources to provide in-person on-site technical assistance to all of its clients. CC-VI used this initiative to develop innovative vehicles to provide followup services and to publicize its efforts. Beyond the public web site devoted entirely to this project [http://www.wcer.wisc.edu/ccvi/cgispider/], CC-VI developed a specialized bulletin board so that teachers can meet, post questions and concerns, and maintain a truly international collaboration as they change and refine their teaching.

This newsletter provides a summary of two years of evaluation of this three-year effort. As is the case in any similar endeavor, I would like to acknowledge the efforts of many people. Professors Thomas Carpenter, Elizabeth Fennema, and Penelope Peterson developed the mathematics professional development program known as CGI almost fifteen years ago. Professors Carpenter and Fennema met with teachers at our CGI Institutes, shared stories with them, and encouraged them to reach all children in their classrooms.

An image that I will always carry with me is one of Professor Carpenter, sitting with a sheepish grin, at the 1999 *Improving America's Schools* (IAS) Chicago Regional Conference, as a group of Dearborn's teachers and administrators sang his praises and lauded a program that he helped to develop. Professors Gloria Ladson-Billings, Carl Grant, William Tate, and Thomas Romberg also met with Institute participants to share their insights on how to teach children of diverse linguistic and cultural backgrounds. We reprint Professor Ladson-Billings' talks to the Comprehensive Center's CGI Institute participants in this newsletter, but the printed page cannot capture the cadences of her voice as the audience sat mesmerized listening to her tell the story of her daughter's having *a strategy*.

From among those to whom I refer as the CGI *first string* — which includes presidential award-winning teachers and first rate mathematics educators, all of whom share a passion for teaching, equity, and student

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learning — I would like to thank Linda Levi, Sue Gehn, Mazie Jenkins, Lisa Byrd Adajian, Sue Empson, Karen Falkner, Annie Keith, Carrie Valentine, Jeannie Behrend, and Megan Loef Franke for their hours of preparation and presentations at these Institutes. I thank Jonathan Brendefur who organized and coordinated the CGI Institutes, ensured appropriate followup services, and oversaw the entire evaluation effort. Without him, this would remain just a dream. Finally, my thanks to Sherian Foster who edited this newsletter and wrote many of its articles.

Ecosystems — Lessons Learned

(...continued from page 3)

new species into an ecosystem. That is, the Comprehensive Center – Region VI *seeds* change. Professional development disturbs the balance in that system. With proper follow up, it is possible to create safe niches in the school's ecosystem within which those changes can take root. It is also possible to rely on the system's own internal mechanisms to spread a desirable change and bring the system into a new dynamic balance. But, as we know so well, it does take time.

[about the author]

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Dearborn — A System Changes

(...continued from page 21)

WONDERFUL BENEFITS

If change is so hard, what keeps Dearborn teachers working to implement and spread CGI? "It's the kids!" All teachers being interviewed agreed. The first teacher continued, "I looked at my students one day, and I was in awe of their ability. I couldn't believe what they did. And I didn't teach them anything! .... It's [all about] understanding, and they were!"

One teacher talked about seeing amazing achievement by her lowest students. "With traditional math," she said, "I would have thought, 'This kid can't do it. This kid, maybe, has a learning problem.' But they have their own ways to figure things out. If we allow them to do that, then we can see their growth." Another teacher told about a very withdrawn ELL student who came out of his shell, learned to read, and began to communicate in English through solving word problems and explaining his strategies.

Teachers talked about students' being empowered by their mathematics achievement and understanding. One teacher said her CGI students were all successful on the end-of-the-book textbook test, and they said, "Why are we doing this? This is so easy!" In one class, a student teacher attempted to teach the standard algorithm for borrowing and carrying. He said, "Now, you carry the one." Students promptly informed him, "No, you're carrying a ten!"

Teachers, too, are empowered with a new level of professionalism. They talked about being confident in standing up to peers who have some case against CGI and about "fighting for" money to be allocated to sustain CGI instead of purchasing unused textbooks and workbooks.

How did CGI take root and spread in Dearborn? Just as students learn from each other in CGI classrooms, teachers learn from teachers what CGI is and how to implement it. Principals and district administrators made this possible in Dearborn by sending teachers to CGI Institutes, giving them time to meet and work together, and using the Comprehensive Center's support services. To date, there are more than forty teachers, specialists, and principals in the Dearborn Public Schools who have spent at least a week learning about CGI. Many of these teachers have implemented CGI in their classrooms for more than two years. DPS has asked these teachers and specialists, in the summer of 2001, to help present a district-wide CGI Institute which may have more than eighty primary teachers in attendance.

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THE NEWSLETTER OF THE COMPREHENSIVE CENTER–REGION VI

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The Comprehensive Center–Region VI is administered by the Wisconsin Center for Education Research, School of Education, University of Wisconsin–Madison and funded by the Office of Elementary and Secondary Education, U. S. Department of Education.

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FROM THE DIRECTOR

[walter g. secada]

THIS ISSUE OF THE COMPREHENSIVE CENTER – REGION VI (CC-VI) *NEWSLETTER* SUMMARIZES TWO YEARS OF PROFESSIONAL DEVELOPMENT TARGETED AT IMPROVING THE MATHEMATICS ACHIEVEMENT OF AT-RISK CHILDREN. WHEN WE FIRST THOUGHT OF THIS EFFORT AND THE SERVICES WE WOULD OFFER, THE CENTER LAID OUT FOR ITSELF THE FOLLOWING CHALLENGES:

Challenge 1

CC-VI services should be drawn from a research-based program with a proven track record of improving student achievement in mathematics.

Recent studies have raised questions about school improvement efforts that claim to be research-based. While many programs invoke the term *research*, few can document enhanced student achievement that has been replicable across contexts. The professional development model that the CC-VI adopted, known as *Cognitively Guided Instruction* (CGI), does have this track record.

Challenge 2

CC-VI services should help teachers improve how they think about their own craft and how they actually teach mathematics.

The CGI Institutes in which teachers participated and the follow-up support given by CC-VI helped teachers to better understand how their own students learn mathematics and how they reason when solving problems. Our evaluation has documented that participating teachers offered a more demanding mathematics curriculum to their students. For example, in addition to learning basic skills, students spent considerable class time solving word problems. The evaluation also documented that CGI students discussed *how* they solved word problems so that they could understand one another's reasoning.

Challenge 3

CC-VI services should improve student achievement in mathematics.

While prior research might suggest that achievement will rise for students in a given program, it is important to ensure that students in that program *do* improve their academic achievement. The evaluation of this professional development program documented enhanced student achievement compared to a matched set of non-program students.

(continued on page 22...)

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EFF-089 (3/2000)