WCER Highlights

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Engage parents in mathematics reform

Although some parents are uncomfortable about new ways of teaching and learning mathematics, schools are finding ways to show them the value of reformed instruction.

Children of all ages are encountering kinds of mathematics different from those their parents received during their school years. Many parents support the changes. Some are unsure, however, of the rationale, content, and expected outcomes of the changes in mathematics instruction.

Some parents are uneasy about the activities that make up a reformed mathematics lesson, where students have more control and are given more responsibility for their learning. Tasks often engage students in small-group discussions.

Students' parents experienced mathematics in conventional classes characterized by a quiet sense of perseverance and monotony. Teachers had unquestionable control of students and assigned them individual seatwork. Some parents comparing new teaching methods to their own school mathematics experiences conclude that today's classes have no structure and that teachers do not have adequate control.

When parents examine their children's homework assignments, they often find themselves on unfamiliar ground. They may not understand the significance of homework assignments that seek open-ended responses, present problems in a variety of contexts,

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From the Director


JEFF MILLER

Charting the evolution of successful teaching

Students are learning different kinds of mathematics than their parents did during their school years. Some parents comparing new teaching methods to "the old days" conclude that today's classes have little structure and that teachers lack adequate control. WCER's National Center for Research in Mathematical Sciences Education team (NCRMSE) has found that parents often become supportive of changes when schools involve them in the new way of doing things.

The National Center for Improving Student Learning and Achievement in Mathematics and Science, which grew out of the NCRMSE, is evaluating a teacher professional development service developed and administered by the Public Broadcasting Service: *PBS Mathline.* Participating teachers say they have benefited from their online communications with their peers and from the new lesson content.

Mathematics students, teachers, and mathematics researchers are benefiting from the annual Mathematics Institutes sponsored by the Institute for Advanced Studies. WCER Researcher Norman Webb and his team evaluated the 1996 Institute and found that high school mathematics teachers in particular liked learning new mathematics, sharing ideas about teaching, and catching up on technology.

Although we at WCER love mathematics, we don't limit our research to that. The ability to write well is crucial to academic success, too. Our knowledge of students' writing processes has grown dramatically over the last couple of decades, and it wasn't until relatively recently that the study of composition was an accepted academic discipline. Researcher Martin Nystrand documents the birth and development of this field of research, which began to coalesce during the 1960s.

Finally, WCER's Tom Kratochwill and Caroline Racine explain a measurement tool they're developing to help school staff identify students who have obsessive-compulsive disorder (OCD) and refer them for treatment. OCD is a serious condition that can interfere with students' social and intellectual development, and the disorder is more common than was previously thought.

By the way, Mathematics and Science Center Director Tom Romberg recently received the National Council of Teachers of Mathematics' Lifetime Achievement Medal in Leadership, Teaching, and Service. On behalf of WCER I want to extend my congratulations to Tom.

For more information about these and other WCER research projects, visit our Web site at http://www.wcer.wisc.edu.

Andy Porter

and require little computation. Parents also voice the concern that this unfamiliar mathematics instruction will affect their children's success in completing secondary education and preparing for college entrance exams.

Researchers at WCER's National Center for Research in Mathematical Sciences Education (NCRMSE) heard school staff express concern about the need to involve parents in mathematics reform. Many schools that began such efforts were initially unaware of the types of reactions the changes could engender in parents. In some cases, schools did not react until the steady stream of parents entering the principal's office forced them to do so. In one extreme case, high school parents packed a school board meeting to express their concerns. The board members voted to reinstate a tracking system and to adopt a conventional mathematics textbook series for the highest-track students. Both the principal and the chair of the mathematics department left the school the following year.

How do schools address parents' concerns? What strategies lead to better understanding between parents and schools where reform curricula are being taught? These questions represent part of the research conducted by NCRMSE's Implementation of Reform Working Group. Rather than focusing on individual teachers and their practices, this research team adopted the viewpoint that schools, or departments in schools, are the significant sites for the reform of the teaching of mathematics. The team found not only that some schools addressed parental concerns more effectively than others, but what tactics worked.

Schools involve parents

Many schools studied had initiated efforts to inform parents about changes in school mathematics. Some sponsored parents' nights at which teachers explained the program and its goals. Some schools taught parents the mathematics lessons in the same ways that their children had been taught. For example, one high school sponsored a parent-switch day where parents, rather than children, came to school, followed the same schedule as their children, and participated in mathematics classes.

One teacher described a father's visit to her classroom. The father observed his child working in a small group solving problems with other children. After listening to the exchanges for some time, he told the teacher that he had just finished his company's training program on how to work in small groups. The father saw the connection

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Composition studies—a child of the sixties

It has been said that there are only two certainties in this world: death and taxes. Students in high school and college would add a third curse to that list: course papers and theses. But it has been only relatively recently that scholars have turned their attention to the teaching and learning of writing.

Although composition theory is now an established discipline in graduate schools across the country, it wasn't until relatively recently that the writing process itself became the focus of theoretical and empirical attention. UW–Madison English Professor and WCER researcher Martin Nystrand spent much of the past two years documenting how this discipline evolved. He interviewed several people associated with Harvard University during the 1960s, recording their first-hand accounts of the circumstances that promoted ideas about writing as a cognitive process. This distinguished group of educators (see sidebar) helped develop empirical methods of research into the writing process. Nystrand's study documents the birth of a discipline that remains important as more students seek help in writing labs and from their classroom teachers.

Among Nystrand's interview subjects were:

- Frank Smith, formerly of the Harvard Center for Cognitive Studies, who coedited (with George Miller) *The Genesis of Language* (1966), an important set of conference papers on language and psychology still in print today. Smith wrote the influential *Understanding Reading* (1971).
- Charles Read, now Dean of the School of Education at UW–Madison, whose pioneering dissertation study on invented spelling reflects his joint focus of linguistics and education. The study became a noted first empirical study of written language development.
- John Mellon, whose dissertation on transformational sentence combining brought linguistics to bear on problems of writing development and included implications for instruction.
- Courtney Cazden, who focused on the role of language in social class differences in children's educability. She worked with Psychology Professor Roger Brown and worked as a research assistant in both the Center for Cognitive Studies and the National Center on Educational Differences.
- Janet Emig, who served on the editorial board of the *Harvard Education Review*, edited a special issue on Language and Learning and wrote the seminal *Composing Process of Twelfth Graders* (1971). The articles were eventually published as a volume by the same name.
- James Moffett, a teacher who was appointed as a research associate at Harvard from 1965 to 1968. Attending classes and seminars in both psychology and linguistics "amplified" his ideas and helped him "discover a vocabulary" for his influential *Teaching the Universe of Discourse* and *A Student-Centered Language Arts Curriculum: K–13*, both published in 1968.

Empirical investigations begin

Until the 1960s, teachers had conceived of student writing in terms of prescriptive, pedagogical concerns about text features. But during the 1960s, ideas about writing underwent a "revolution" as teachers began to think of writing as a process of composing. The prescriptive point of view gave way to empirical investigations and descriptions of writing (and reading) as cognitive information processing.

Nystrand's interview subjects were in some way touched by the "Cambridge Cognitive Revolution" of the 1960s. They took courses or attended lectures with leading academics on language and learning at both Harvard and MIT, including Roger Brown. Jerome Bruner, Noam Chomsky, and George Miller. During the 1960s, when the shift to discipline-based educational research occurred within Harvard's Graduate School of Education, a similar shift occurred within Harvard's Graduate School of Arts and Sciences. There Professors Bruner and Miller established the Center for Cognitive Studies to conduct basic research on learning and reading (among other areas).

The National Institute of Education funded the Center for the Study of Reading and eventually the Center for the Study of Writing. Universities eventually initiated new doctoral programs in composition studies, scrambling to hire writing researchers. In this climate new discourse on both writing and reading became influential, and the participants in Nystrand's study were "discovered."

Educational priorities were shaped by social forces as well. Chief among these, Nystrand says, was the public perception of a literacy crisis in the 1970s related partly to expanded college enrollments starting in the late 1960s. Private foundations, university researchers, and the National Institute of Education all came to view research on both writing and reading as a national priority. As the landscape of graduate education and research training at Harvard dramatically shifted, Nystrand says, these new contexts provided impetus to, and

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Nystrand found that urban universities were at the forefront of advances in writing instruction.

Mathline takes learning to teachers

Teachers' professional development is an important part of school reform, but because of budgetary constraints and time limitations teachers often do not have many professional development opportunities. In an effort to make professional development more convenient for K–8 mathematics teachers, the Public Broadcasting Service (PBS) offers an online service called *PBS Mathline.*

PBS and the National Council of Teachers of Mathematics (NCTM) have collaborated to establish 91 *PBS Mathline* collaborative learning communities across the country. Participating public television stations offer the programming in cooperation with local education entities and teacher groups. A practicing mathematics teacher facilitates each local learning community of 20 to 30 participants. Local PBS stations provide the technical support to get teachers on line, deliver the video lessons, and furnish locally designed services and activities for the teacher-participants. Stations cooperate with local colleges and universities to arrange credit for participating teachers.

Taking advantage of E-mail networks and video technology, *PBS Mathline* participants use their VCR, television, computer, and modem. Teachers can participate at school or at home, at any time that's convenient. Because each learning community involves teachers "local" to the public television station, *Mathline* seminars reflect local and state mathematics goals and standards. A national bulletin board and national plenary sessions allow participants to interact with fellow teachers across the nation and with experts on mathematics topics and issues.

Under the guidance of Thomas A. Romberg, director of WCER's National Center for Improving Student Learning and Achievement in Mathematics and Science, WCER Researcher Beth Cole is evaluating the PBS Elementary School Math Project (ESMP), a part of *Mathline* aimed at mathematics teachers in grades K–5. Cole says the ESMP serves important needs for a variety of individuals in providing long-term professional development. She chose four sites for close study because they responded well to an initial survey.

ESMP teacher-participants invest two to three hours a week over an academic year. "The online component is what makes this service different," Cole says. "PBS doesn't just create a set of videos and send them out to teachers." Instead, a teacher-facilitator leads discussions on issues and ideas developed in the video lessons, on mathematical topics of common interest, and on educational issues related to teaching, learning, and assessment. Participants then correspond via E-mail about the videos they've seen and address issues crucial to effective teaching. They share experiences, pose questions, and respond to each others' ideas.

For the past year, Cole has collected teachers' impressions about the video component and the online component service. She has asked the teacher-facilitators about the kind of support they need, and what has worked and not worked. She has analyzed the kind of communication the groups produced and has gathered demographic data to determine whether the service serves a representative group of elementary school teachers.

Teachers share experiences

Participating teachers say that the major benefits have been the professional community that develops, the learning that takes place, and the lessons. Many teachers said they had begun to change their teaching before participating in *Mathline* but that the project had encouraged them to continue the changes they were making. Many said that because of the project they have begun to expect more from their students. One teacher who works with multiple grades noted that she now thinks about how topics grow over grade levels. Others mentioned that they had learned about new areas of mathematics that they were now incorporating into their teaching.

The frustration mentioned most frequently by the participants was a lack of time—both time in their day to take advantage of what ESMP had to offer, and time in their curriculum to fit the lessons in. The next most-often-mentioned frustration was their peers' lack of full participation in the online community. Another frustration was trouble identifying and gathering the materials needed for the lessons.

But far outweighing the frustrations for almost all teachers were the benefits of participating. The most frequent topic mentioned as a benefit (by about 70 percent of the participants) was the chance to share with others and to be a part of a professional community. Many teachers mentioned some aspect of learning as a benefit, either their own learning or their students' learning. The facilitators mentioned the learning evidenced by others in the community. One comment made frequently was that face-to-face meetings with other participants, either prior to or during the project, seemed to improve the online conversations. Some respondents said they considered the face-to-face meetings critical to their community's success.

Putting lessons into practice

ESMP lesson content includes geometry and spatial relations, statistics and probability, number sense and numeration, patterns and relationships, fractions and decimals, and measurement. For the most part, participants were complimentary and excited about the lessons, both as they were on the tape and as they played out in the classroom. Almost all participants reported teaching at least one lesson, and a few participants indicated that they had tried parts of all 20 lessons.

Participants said one of the highlights of the program was the set of video lessons, which show teachers planning lessons and teaching in their classrooms. While some teachers expressed a few pedagogical concerns and equity concerns about some videos, reviews were positive overall. Teachers said they liked being able to watch a video of a lesson before they presented the lesson in class. One facilitator commented that viewing lessons prior to teaching them helped teachers to decide whether and how they would modify the lessons for their students. Preservice teachers commented that it was useful to see different models of teaching and to see standards-based classrooms in action.

The videos served differing roles for different participants. Some worked hard watching the videos and preparing the lessons for their classes while doing little on line. Others concentrated their time primarily on line and found the videos less useful.

Facilitators encourage participation

Facilitators reported spending an average of 30 minutes to ten hours per week on line, posting messages and responding to questions from the local community. About one-third reported averaging between zero and two hours per week on line, and another one-third reported spending between three and five hours per week on line. About 70 percent of the facilitators considered their workload appropriate while the rest found it difficult or overwhelming. Most facilitators reported that their biggest challenge was getting people to participate in the online discussions.

WCER researcher Beth Cole found that teachers participating in the PBS professional development program were encouraged to continue changes they were making.

Having studied a sample of 300-plus E-mail messages from four of the learning communities, Cole says that the facilitators posted the most messages, sometimes more than twice as many as the next-most-active participant. Some members in each of the four learning communities did not post messages, but read many or most of the messages posted. More than half of the messages concerned the teaching and learning of mathematics. Of the 333 messages Cole sampled, 20 percent concerned the ESMP lessons; 38 percent discussed mathematics, but not ESMP; 16 percent concerned other educational issues; and 26 percent discussed non-educational topics, for example, technical questions about the project or the software itself.

Funding for *PBS Mathline* comes from the AT&T Foundation, the Carnegie Corporation of New York, the U.S. Department of Education's Office of Educational Research and Improvement, the Corporation for Public Broadcasting, and the Cellular Telecommunications Industry Association (CTIA) Foundation for Wireless Telecommunications.

More information about *PBS Mathline* is available online at http://www.pbs.org/learn/mathline. For more information about the WCER evaluation, contact bethcole@macc.wisc.edu.

Institute benefits high school math teachers

WCER's Webb says the Mathematics Institutes bring together undergraduates, researchers, and everyone in between.

High school mathematics teachers enjoy sharing ideas about teaching and learning mathematics, but it's not always easy to do so. Mathematics teaching and learning tend to be fragmented. Individual groups—high school mathematics teachers, mathematics researchers, graduate students, and undergraduate mathematics majors—tend to work and socialize within their own peer groups. Some mathematicians and mathematics educators have realized that, if these groups could intermingle more often, mathematics as a whole would benefit.

Now there's a place where, for a brief time each year, representatives from all of these groups can meet in a supportive setting to discuss mathematics and how it can be best taught and learned. The Institute for Advanced Study (IAS) hosts a Mathematics Institute every summer to advance mathematics and mathematics education and to integrate research and practice. Alternating between Princeton, New Jersey, and Park City, Utah, the Mathematics Institute aims to create extended learning communities whose members participate in a wide spectrum of mathematics and education activities.

For the past two years, WCER researchers have evaluated how well the Mathematics Institute has achieved its goals. Their analyses help decision makers refine and develop models for integrating research and practice across different levels of mathematics education and research.

The 200 or so participants in the 1996 Institute attended a variety of lectures, research presentations, activity sessions, computer laboratory sessions, and problem sessions. WCER researchers Norman Webb, Donald Chambers, and Daniel Heck sought and analyzed participants' comments about their experiences, including such things as the quantity and quality of their interactions with members of other groups, any deeper knowledge of mathematics they gained, any change in high school teachers' teaching practices, and any increase in the volume and quality of research by those in higher education.

About half of the 200 participants in the 1996 Institute completed surveys. They generally rated their overall satisfaction with the Institute very high. Twenty percent rated their overall satisfaction extremely high. The undergraduates, the graduate students, and the researchers identified "learning mathematics" and "interacting with other Institute participants" as their most valuable experiences.

Of the 1996 Institute participants, 38 were high school teachers. The 31 who completed surveys reported that they were very satisfied with the schedule, the course, content, and the faculty. They identified the sharing of ideas about teaching as the main benefit of their interactions with other high school teachers. Eleven teachers mentioned the value of collaboration with other teachers, and eight referred to the acquisition of new teaching ideas as their most valuable experience. Six teachers mentioned collaboration with members of other programs (i.e., researchers, undergraduates, and graduate students), and seven teachers identified learning new mathematics as their most valuable experience. Six teachers mentioned their experiences with graphing calculators and computer technology as most valuable.

More than half (52%) of high school teachers reported daily interactions with researchers as valuable. Slightly fewer (45%) reported daily interactions with graduate students, and fewer still (36%) reported daily interactions with graduate students and researchers.

After tallying the results with those of the 1995 Institute, Webb's team found that the 1996 participants generally interacted with those in other programs slightly more often than in 1995, yet researchers interacted with teachers and undergraduates significantly less often in 1996 than in 1995. Webb explains that generating significant interaction among the mathematicians, graduate students, undergraduate students, and high school teachers is very difficult. "Yet," he says, "the Mathematics Institute has made important headway in removing boundaries among these groups. Structural changes are being considered that are likely to increase the frequency and depth of interactions among programs in upcoming Institutes."

Webb's study was funded by the National Science Foundation through a subcontract with the Institute for Advanced Study. For more information about the Institute itself, see the Institute for Advanced Study Web site at http://www.ias.edu/geninfo.html; for information about the evaluation contact normwebb@macc.wisc.edu.

Parents

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between what his child was doing and what the jobs of the future would require.

Two mathematics departments in larger high schools maintained both a "traditional" and an "experimental" program. Before choosing a program to enroll in, students and their parents were given information on program goals and structures. The departments provided students with options for transferring from program to program at key points in the year.

Some schools use newsletters and other media to inform parents about programs. One school, for example, invited a local television station to cover NCRMSE researchers' visit. Two schools set up interviews for visiting researchers with a local newspaper. Some schools asked local businesses to contribute in-kind, personnel, and financial resources to support new programs. Parents saw these contributions as a legitimization of school efforts.

But occasionally, school efforts left parents unconvinced. This situation arose when "reformed curriculum" students scored less well than "standard curriculum" students on the computational part of a standardized test, or when a school's overall test results published in a local newspaper were down. In these cases, teachers, department chairs, or principals have not always been successful in addressing parent concerns. The principals, however, have remained steadfast in their support of teachers' reform efforts.

A principal reflects

As parents become more involved in their children's mathematics education, their understanding of what their children are experiencing increases. As a result, they frequently increase their support and enhance the school efforts to reform its mathematics program. A high school principal expressed this idea while reflecting on the parental support that his school had garnered:

"You make sure that you involve as many parents from the community as you can. We have parents' night, parent advisory groups, and small groups like [the one you visited] as a part of the parent advisory group. We do an awful lot of public relations. . . . I think the main thing that we do a pretty good job of is keeping parents informed about what's going on. . . . People are always a little concerned about change and so you try to have community meetings and try to inform people. And there will be people who will challenge it, of course, but . . . we worked with our community, and I think for the most part they are in support of it."

Parents frequently increase their support as they understand more about their children's mathematics experiences.

For more information about the NCRMSE working group findings, see:

Dominic Peressini, "Building Bridges Between Diverse Families and Mathematics Classrooms: Parent Involvement in Mathematics Education," in *Multicultural and Gender Equity in the Mathematics Classroom: The Gift of Diversity, 1997 Yearbook*, edited by M.M. Trentacosta (Reston, VA: National Council of Teachers of Mathematics, in press).

Cuban, Larry. *How teachers taught: Constancy and change in American classrooms 1880–1990.* New York: Teachers College Press, 1993.

[Adapted from "Parents and the Reform of School Mathematics," *NCRMSE Research Review*, Volume 4, Number 1.]

Parents are concerned about how the reform of school mathematics will affect their children's future opportunities. As teachers teach problem solving and focus on algebraic, geometric, and statistical concepts, parents see less emphasis on the content they experienced as important: basic number facts and algorithmic procedures.

One parent interviewed found that his daughter's mathematics teacher was focusing on conceptual understanding in solving linear equations rather than on showing her a quick algorithm to get the answer. He responded by showing her how to use an algorithm and assuring her that it was a "better" way to do the problems. His response placed the parent and teacher at cross-purposes, creating a tension between teacher and parent and between teacher and child.

Parents tend to be more supportive when schools inform them adequately about the changes and make clear what the children will experience.

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Composition

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funding for, empirical studies of language and literacy development and provided research experience for many doctoral students.

Student demographics change

A student and tutor discuss a paper in the UW–Madison's writing laboratory.

Nystrand notes the special role played by urban universities such as the City University of New York (CUNY) and the University of Illinois at Chicago (UIC) in the development of composition studies. "These universities were on the front lines of expanding college enrollments, and they were among the most innovative in their efforts to improve writing instruction," Nystrand says. "Most notable were the open admissions era efforts of Mina Shaughnessy at City College and Ken Bruffee of Brooklyn College, both of CUNY. The development of their thinking as they struggled to meet instructional challenges provides a unique window onto the effects of material contexts (such as changing student demographics and radical campus politics) on the development of ideas (such as social constructionism). It was urban universities like the University of Illinois at Chicago, moreover, that were among the first to offer Department of English Ph.D.'s in composition studies. The more established campuses (like Urbana) came on board later."

The story of composition studies, Nystrand says, is largely about a marginalized academic concern involving marginalized students on marginalized campuses, and what happened when they each, in their own way, strived for legitimacy.

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