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WCER RESEARCH highlights

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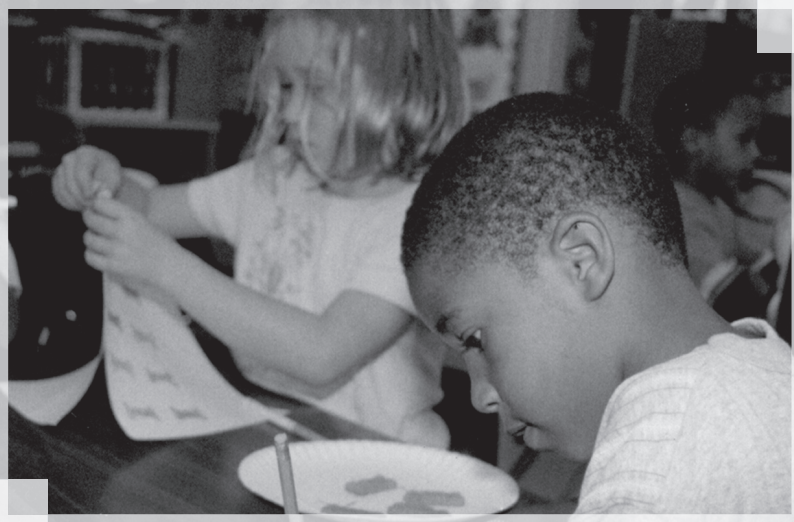


Scaling Up Innovative Practices in Math and Science

Recommendations for reforming math and science education in the U.S. call for fundamental changes in the math and science content taught in schools and in the approaches to teaching that content.

For 8 years, researchers at WCER's National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA) worked with teachers and schools to create and study classrooms in which compelling new visions of mathematics and science are becoming the norm.

To support teacher change and enable these visions to "travel" to other classrooms, NCISLA researchers sought to understand how the transformed classrooms function, what it takes to create them, and how this knowledge can be used to launch similar classrooms in new settings.

NCISLA Director Thomas Carpenter and colleagues* found that fundamental reforms in mathematics and science learning and teaching are most likely to be achieved through professional development grounded in teacher inquiry and student conceptual understanding. How successfully an innovation travels across diverse conditions and geographical areas depends on the extent to which a teachers' professional community is established.

From 1995 to 2003, NCISLA conducted an integrated program of research that connected (a) the development of students' understanding of core mathematics and science content and practices, (b) classroom instruction and assessment that supports learning with understanding, (c) professional development that fosters teaching for understanding, and (d) the organizational capacity required to support professional development and the emerging instructional practices.

Since 2000, NCISLA has focused on how to use this research to develop successful instructional practices in new settings.

Given the ambitious vision of learning and instruction that Carpenter and colleagues embrace, these efforts present challenges, yet hold promise for student and teacher growth.

This article, the first of four parts, focuses on NCISLA's findings about learning with understanding, which provide the foundation for all of the center's research.

Part 2, to appear in the next issue, will explain what teachers need to know to help students

(continued on next page...)

CONTENTS

FROM THE DIRECTOR

New Studies Released

In this issue of WCER Research Highlights we're introduced to a recent study which found that fundamental reforms in mathematics and science learning and teaching are most likely to be achieved through pursuing professional development based in teacher inquiry and student conceptual understanding. How successfully an innovation 'travels' across diverse conditions and across geographical areas depends on encouraging teachers' professional community.

Another recent study compared the effects of traditional and 4x4 block schedules on the academic achievement of students with and without disabilities from a random selection of high schools. The study found that partitioning the school day into shorter 60-minute periods or longer 90-minute periods did not necessarily result in different academic achievement by the two group of students.

Among education researchers, the evidence-based interventions (EBI) movement has gained great momentum, especially in the fields of psychology, education, and prevention science. The Task Force on Evidence-Based Interventions in School Psychology is working to identify, review, and code studies of psychological and educational interventions that target behavioral, emotional, and academic problems and disorders in school-aged children.

And finally, a tool developed by WCER's Surveys of Enacted Curriculum project offers a practical way to collect, report, and analyze data about what, and how, teachers teach. This data makes it possible to compare one school's patterns of content coverage and classroom practice to district and state standards and assessment results.

As always, you're invited to explore these areas in more detail at our web site, ***www.wcer.wisc.edu.***

L. Allen Phelps

Interim Director

Professor of Educational Administration

learn mathematics and science with understanding and what administrators need to know to design professional development fostering teaching for understanding.

Part 3 will discuss requirements for school organization that supports teaching for understanding.

Part 4 will focus on what travels, what conditions are necessary for travel to occur, and how similar classrooms can be created in new settings.

Learning with understanding

The foundation for NCISLA's work with students and teachers was its conception of learning with understanding. Understanding is seen as continuous mental activity rather than as a static attribute of an individual's knowledge.

NCISLA research (citations on page 7) found that mathematical and scientific understanding emerges from four related forms of mental activity:

1. constructing relationships,
2. extending and applying mathematical and scientific knowledge,
3. justifying and explaining generalizations and procedures, and
4. taking responsibility for making sense of mathematical and scientific knowledge.

This framework applies not only to NCISLA's analyses of children's thinking and learning, but also to its characterization of instruction and professional development programs that support learning with understanding.

Carpenter says a major goal of NCISLA's research and development efforts has been to help students and teachers develop a predisposition to understand — and the conviction that understanding is important to them. When this goal is met, teachers and students become reflective about the activities they engage in while learning or solving problems; they look for relationships among concepts that might give meaning to a new idea; they critically examine their existing knowledge as they look for and apply knowledge to develop new and more productive relationships; and they view learning as problem solving in which the goal is to extend their knowledge.

Understanding as a community activity

Learning with understanding generally has been thought of as a process involving the individual. Learning, however, often takes place in groups, and one of the benefits of thinking about understanding as a process rather than an attribute is that one is able to see how understanding can unfold within communities of learners as well as within individuals. The various communities studied by NCISLA were engaged in practices of generating knowledge. Conjectures were proposed, and members of a group worked together to refine and validate those conjectures. Artifacts adopted by the community became a basis for collective reflection and articulation of ideas.

Thomas Carpen-

(continued on page 7...)

Block Scheduling: Some Benefits but No Magic Fix

Brian Bottge

John Gugerty

Block scheduling can take a number of different forms but generally results in fewer but longer classes than traditional schedules permit. Proponents of block schedules have cited several advantages for students, such as more uninterrupted class time and fewer classes in one semester. Advantages for teachers parallel those for students and include longer periods of instructional time, fewer classes to prepare for, and fewer students to teach in one day.

Despite the popularity of block scheduling, research findings are mixed and show no clear advantage of one schedule over the other. The inconsistency of these results leaves school administrators with no clear direction about whether they should stay with traditional schedules or risk changing to one of the block schedule variations.

UW-Madison education professor Brian Bottge and colleagues John Gugerty, Ron Serlin, and Kyoung-Suk Moon recently compared the effects of traditional and 4x4 block schedules on the academic achievement of students with and without disabilities from a random selection of high schools. They found that partitioning the school day into shorter 60-minute periods or longer 90-minute periods did not seem to result in different academic achievement by the two groups of students.

Reasons for block scheduling

The 1997 reauthorization of the Individuals With Disabilities Education Act required that students with disabilities be given opportunities to learn challenging curricula alongside their peers without disabilities. This change in the law has generated new and intense research efforts to find strategies for supporting and enhancing the learning of students with disabilities in the general education classroom.

One way school leaders have responded to these pressures is by redistributing the school day into longer and more flexible blocks of time. For example, block schedules have been recommended to give more time to engage students in activity-based learning opportunities. These changes, some predicted, would eventually result in higher expectations, substantial curricular changes, and improved learning experiences.

As noted, these expectations have not been met. However, Bottge does not find the new research findings surprising. His research showed that teachers on block schedules did not in fact use alternative instructional strategies; rather, teachers assigned to each type of schedule used similar instructional strategies. Moreover, teachers on both schedules

- were satisfied with their jobs and their school schedules;
- spent about the same amount of time on various instructional activities;
- expressed similar confidence in their ability to meet the needs of students with disabilities; and
- reported similar levels of collaboration between general and special education teachers (although teachers on block schedules valued collaboration more than teachers on traditional schedules).

Reasons other than academic achievement may justify school leaders' decisions to change from traditional to block schedules. However, if changing to block schedules does not meet the reform and legislative objectives of achieving higher academic performance, the time and money used to make the change may be better used, for example, to develop and train teachers on implementing more effective instructional methods. Of course, professional development may also be the key to making good use of block scheduling.

It can be argued that student and teacher satisfaction with longer class periods and fewer classes may be adequate reasons to make the switch to block scheduling. Ultimately, however, student achievement may depend less on how the school day is partitioned than on what teachers and students accomplish in the classroom.

For more information, contact Bottge at bbottge@education.wisc.edu, or go to the project's web site at ***http://www.cew.wisc.edu/block/***

Some material in this article originally appeared in NASSP Bulletin, vol. 87, no. 636 (September 2003), pp. 2-14.

This research project, H324C990018, was funded at 100% by the U.S. Department of Education, Office of Special Education and Rehabilitative Services, Field Initiated Research Projects, from July 1, 1999 - June 30, 2003 for a total of $531,121. The views expressed in this article do not necessarily represent the policy of the Department of Education, and the reader should not assume endorsement by the Federal government.

Analyzing Instructional Content

Students perform best on tests that assess subject matter content they have had the opportunity to learn. Though supported time and again by research*, this observation is little more than common sense. Until recently, however, educators have had little ability to examine the relationship between the content of assessments and the content of instruction. New developments in survey instrumentation and procedures for conducting content analyses of assessments and standards are making it easier for researchers, teachers, and others to look at the relationships between instruction, assessments, and content standards in a more detailed way than ever before.

Surveys of Enacted Curriculum

The tools developed by the Surveys of Enacted Curriculum (SEC) project offer a practical way to collect, report, and analyze data about what, and how, teachers teach. This data makes it possible to compare one school's patterns of content coverage and classroom practice to district and state standards and assessment results.

Evaluating and improving curriculum in language arts, reading, math, and science require reliable, comparable data on the degree of consistency in subject content taught and classroom practices used. SEC offers a quantitative method for analyzing instructional content and practices that provides data for making decisions on improving curriculum and instruction. The surveys help educators

1. align curriculum, instruction, and assessment;
2. track school performance against standards;
3. monitor changes in instructional practice at the school and their effects on student performance; and
4. identify professional development needs.

SEC engages teachers in honest, open, and objective dialogue about teaching. SEC supports reading and English language arts, mathematics, and science—the subjects targeted by the No Child Left Behind Act.

SEC was developed by a collaborative of state education specialists and WCER researchers. The collaborative is led by Rolf Blank, director of education indicators at the Council of Chief State School Officers (CCSSO). Much of the survey design and content is based on research conducted by former WCER Director Andrew Porter (now at Vanderbilt University) and WCER researcher John Smithson.

The enacted curriculum surveys provide teachers a detailed set of indicators that support reflection on their instructional strategies and can inform their curriculum planning (see Fig. 1, next page). When combined with content analyses of state standards and assessments, the SEC data provide an efficient and highly quantitative means for calculating alignment measures that can be used by researchers and others to examine issues of alignment of instruction to assessments and standards, as well as the alignment of assessments to standards.

A Tool for Policymakers

Administrators and instructional resource staff use SEC results to plan professional development, monitor progress toward local and state curriculum reform goals, and initiate conversations among teachers about issues related to strengthening curriculum and instruction. By using the SEC Online web site (***www.seconline.org***), teachers complete the surveys on-line, review and reflect on their own results, and compare their results to their school, district and state.

The survey data can serve as a basis for workshops focused on curriculum and instruction. A compact disc contains several professional development activity guides and materials designed to engage teachers and other education professionals in activities related to curriculum and instruction.

SEC data provide policymakers a tool for collecting information about classroom practice on a scale not possible through observation or interview methods. Such large-scale data provide a means for establishing a baseline and monitoring progress on goals related to curriculum and instruction. Educators can then examine the effects of policy tools and initiatives.

Researchers can use the SEC tools to analyze the effects of instruction on student achievement. Additionally, by providing a means for holding instruction constant in statistical analyses, SEC helps researchers to better examine the contribution of competing pedagogies to student achievement gains.

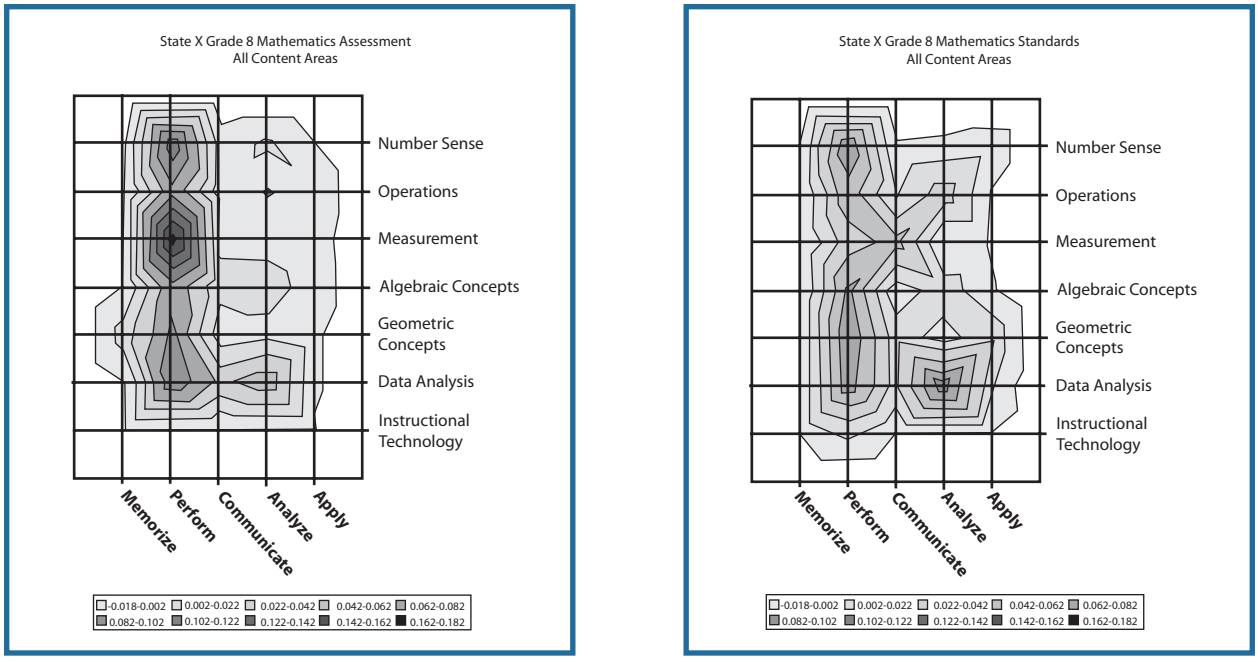


Fig. 1. *SEC data here are plotted along a grid to allow comparisons of assessments (left) and standards (right).*

Scenarios Illustrate Uses

Following are three scenarios illustrating the ways schools can use SEC (see ***www.secsupport.org***):

1. ***To align curriculum with assessments:*** Sandy Long, the principal of Shady Tree Elementary, wants to launch an initiative to more closely align what is taught in the classroom to the state standards and assessments. She uses SEC to provide a baseline measure of her teachers' instructional practices in English/language arts. She'll identify gaps and institute changes in the curriculum. She plans to work with her staff to administer SEC again next year to assess progress.
2. ***To align algebra curricula across multiple courses:*** Teachers at Mountville High School have been asked to improve the alignment between algebra courses. They decide to use SEC to look at Pre-Algebra, Algebra I, and Algebra II. With the results from their surveys in front of them, the teachers begin to have conversations about what changes need to be made to make sure students completing one course are prepared for the next. After talking about the curriculum, the teachers also look at how different practices in the classroom affect student learning.
3. ***To improve professional development in science:*** Connersville School District has hired Maria Thompson, a professional development consultant, to explore what professional development is needed by district middle school staff, particularly in the area of science. As a starting point, Maria administers the SEC science content and practice surveys to the teachers to assess their professional development needs and wants. In addition to helping identify professional development needs, the SEC process will create a constructive and open conversation about professional development among school staff.

Smithson says that using SEC data allows educators to work smarter, not harder. "Many schools are demanding that teachers examine assessment results and identify ways to raise scores," Smithson says, "but those results provide teachers only very limited information about the nature of the assessed content. The SEC data provide an important tool for assisting teachers in making decisions about what content to cover, and how to cover it."

For further reading:

* Gamoran, A., Porter, A.C., Smithson, J., & White, P.A. (1997). Upgrading high school mathematics instruction: Improving learning opportunities for low-achieving, low-income youth. *Educational Evaluation and Policy Analysis,* 19(4), 325-338.

McKnight, C.C., Crosswhite, F.J., Dossey, J.A., Kifer, E., Swofford, J.O., Travers, K.J., et al. (1987). *The underachieving curriculum: Assessing U.S. school mathematics from an international perspective.* Champaign, IL: Stipes.

Rowan, B. (1998). The task characteristics of, teaching: Implications for the organizational design of schools. In R. Bernhardt, C.N. Hedley, G. Cattaro, & V. Svolopoulos (Eds.), *Curriculum leadership: Rethinking schools for the 21st century.* Cresskill, NJ: Hampton Press.

More information online:

* Surveys of Enacted Curriculum, ***www.seconline.org***;
* Learning Point Associates, ***www.secsupport.org***;
* Council of Chief State School Officers, ***www.ccsso.org/projects/Surveys_of_Enacted_Curriculum/***.

Support for SEC development was provided by member states, the National Science Foundation, Learning Point Associates, and the U.S. Department of Education.

John Smithson

Evidence-based Interventions in School Psychology

When it comes to the delivery of mental health services, most people picture a clinical setting. In reality, for children the most common setting is the school. In fact, for many children, school is the only place mental health services are available.

School psychologists, and the psychological and educational interventions they implement, are thus important to the lives of growing numbers of children.

In this context, UW-Madison professor Thomas R. Kratochwill and graduate student colleague Elisa Steele Shernoff emphasize the importance of adopting evidence-based interventions (EBIs) in school practice—that is, interventions whose efficacy is demonstrated by a credible body of scientific work. Among education researchers, the EBI movement has recently gained great momentum, especially with current developments in the fields of psychology, psychiatry, education, and prevention science.

Kratochwill and Shernoff participate in a task force based at UW-Madison that examines the multiple roles that practitioners, researchers, and trainers play as they integrate EBIs in practice. The Task Force on Evidence-Based Interventions in School Psychology was formed to identify, review, and code studies of psychological and educational interventions targeting behavioral, emotional, and academic problems and disorders in school-aged children.

The Task Force aims to improve the quality of research training, to extend knowledge of evaluation criteria for EBIs, and to disseminate this knowledge to the profession of school psychology. An ultimate goal is to promote the use of EBIs in the fields of psychology and education, and specifically in school psychology.

Integrating EBIs in practice

The EBI movement has attracted increasing interest among researchers and practitioners in disseminating and using research-based interventions in practice. Yet using EBIs in practice has raised a new set of challenges. For example, the use of manual-based treatments or procedures may run counter to trainers' and practitioners' philosophical or theoretical beliefs.

Kratochwill and Shernoff point to four issues related to adopting and sustaining EBIs in practice settings:

1. More and more educators and groups are reviewing research with the intent of establishing an evidence base for their work. Although there is some overlap in the coding criteria in use, the diversity of efforts has created challenges for consumers.
2. Integrating EBIs into practice is not always well tailored to the realities practitioners face—for example, administrative and practical barriers that are not present in research settings.
3. When designing, implementing, and evaluating their own interventions, some psychologists may be more influenced by clinical judgment than by research supporting EBIs.
4. Many psychologists—both trainers and practitioners—lack the training to implement EBIs in their school practice. Teachers are also often involved in implementing interventions in schools, further increasing the complexity of adopting EBIs and meeting training needs.

Graduate training programs in clinical, counseling, and school psychology often promote a view of the school psychologist as a "scientist-practitioner." This is a demanding role in that it requires the school psychologist to bridge the gulf between research and practice. The challenges of adopting EBIs go to the core of traditional problems surrounding the scientist-practitioner model.

Researchers, trainers, and practitioners share responsibility for meeting the challenges posed by the adoption and implementation of EBIs in practice settings. Sharing this responsibility means

1. working together to evaluate the feasibility and effectiveness of EBIs that are integrated into practice and training settings, and
2. valuing practitioners' experience with EBIs and their contribution to the scientific knowledge base related to EBI practices.

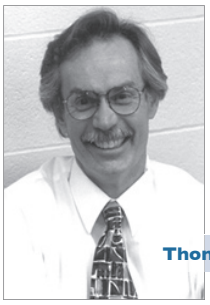
Kratochwill and Shernoff offer the following strategies for promoting evidence-based practice:

1. Develop a practice-research network in school psychology;
2. Promote an expanded methodology for evidence-based practices that takes into account the implementation of EBIs in practice as well as research contexts;

3. Establish guidelines for school psychologists to use in implementing and evaluating EBIs in practice;
4. Create professional development opportunities for practitioners, researchers, and trainers; and
5. Forge a partnership with other professional groups who wish to make more use of EBIs.

These strategies are designed to establish a link between research and practice that will help psychologists better understand the effectiveness of interventions.

For more information, see the WCER working paper, "Evidence-Based Practice: Promoting Evidence-Based Interventions in School Psychology" available at ***http://www.wcer.wisc.edu/publications/workingpaper/abstract/Working_Paper_No_2003_13.asp.***



Thomas R. Kratochwill

Elisa Steele Shernoff

SCALING UP INNOVATIVE PRACTICES IN MATH AND SCIENCE (continued from page 2...)

* Carpenter's colleagues include Maria Blanton (University of Massachusetts -Dartmouth), Paul Cobb (Vanderbilt University, Peabody College), Megan Loef Franke (University of California -Los Angeles), James Kaput (University of Massachusetts -Dartmouth), and Kay McLain (Vanderbilt University, Peabody College).

For more information:

Carpenter, T. P., Blanton, M. L., Cobb, P., Franke, M. L., Kaput, J., & McCain, K. (2004). *Scaling up innovative practices in mathematics and science.* Madison: University of Wisconsin-Madison, National Center for Improving Student Learning and Achievement in Mathematics and Science. Retrieved May 26, 2004, from ***http://www.wcer.wisc.edu/ncisla/publications/reports/NCISLAReport1.pdf***

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Gamoran, A., Anderson, C., Quiroz, P., Secada, W., Williams, T., & Ashmann, S. (2003). *Transforming teaching in math and science: How schools and districts can support change.* New York: Teachers College Press.

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Powerful Practices in Mathematics and Science ***http://www.wcer.wisc.edu/ncisla/research/powerful.html***

National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA) ***http://www.wcer.wisc.edu/ncisla/***

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WCER RESEARCH highlights

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