



WCER Highlights

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It's in the genes



Part of learning science is developing teamwork skills and persuasion skills.

Science in the making

The school curriculum can become a topic of heated public debate. Last year, for example, the Kansas Board of Education removed any direct reference to the word "evolution" from the state's science standards.

But the turmoil over a standards item raises a broader question: How do students best learn science? The science that many of us learned in school was "ready made." Textbooks were full of hindsight of scientific research, but they provided little sense of why or how the research was conducted.

By contrast, WCER researcher and classroom teacher Susan Johnson sees her classroom as an opportunity for students to experience "science in the making." Johnson teaches at Monona Grove (Wisconsin) High School and is a researcher in WCER's National Center for Improving Student Learning and Achievement in mathematics and science. Students in Johnson's high school genetics course work in research groups to pose and solve problems, build explanatory models for phenomena, revise those models to explain anomalies, and defend and critique those models.

WCER Highlights



Winter 1999-2000
Vol. 11, No. 4

- 3** The pros and cons of "holding out"
- 4** Benefits of board certification
- 6** Teacher research spurs professional development

From the director

Making a good thing better

Teachers are people who love learning, and the best teachers never stop finding ways to improve their practice. This issue of WCER Highlights features two stories about teacher professional development.

Ken Zeichner has completed a meta-analysis of studies of teacher research activities in various parts of the country that seem to be having positive effects not only on the teachers but on their students' learning.

Carolyn Kelley and Steven Kimball have studied the effects of teachers' earning certification from the National Board for Professional Teaching Standards. They found that Board certification leads to better teaching skills and more opportunities for exercising leadership, but that certification has not yet had a major influence in teachers' broader professional communities.

Also in this issue are stories about the benefits and drawbacks of holding out five-year-olds from kindergarten for an extra year and about some fascinating work done in a high school genetics class.

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

Andy Porter



JEFF MILLER

(appearance), and they explain and predict the types of offspring possible from any two-parent organisms.

Over the next few weeks the collections of organisms (generated by the computer) exhibit anomalous data that are the result of modes of inheritance other than simple dominance. Because the students have no models that explain these data, they must revise Mendel's model to explain the anomalies. However students do not go to text or teacher for the answer. In this effect-to-cause problem solving, similar to that done by classical geneticists, the problems are open-ended. There is no one-and-only-one solution, because multiple models can be proposed and defended.

"Watching students defend their models and explain their thinking is convincing evidence that we generally underestimate the contribution students can make to their own learning."

"In this process students become invested in what they do," Johnson says. "They feel an ownership of ideas, which, as seen from their excitement, was a very powerful motivator. They also develop a deeper understanding of genetics, because they develop their own models rather than solely memorizing something presented to them already in final form."

Teams learn to persuade

Students also experience the important scientific activity of persuasion. First, they persuade themselves about the adequacy of a particular model. Then they persuade others within their research group. They share their models at classroom conferences. "It's a very powerful moment when a student model is successfully used to predict the results of a particular cross," Johnson says. "Watching students defend their models and explain their thinking is convincing evidence that we generally underestimate the contribution students can make to their own learning, and to that of their classmates."

Students also prepare scientific posters that document the group's methods, the data they used, and a model they developed. The poster session is attended by peers, parents, teachers, and administrators. "The student groups are even more impressed with what they have accomplished when they describe their models to others outside the classroom and use those models to explain various human traits," Johnson says.

continued on page 8

Students develop their understanding of genetics by building explanatory models for modes of inheritance (such as recessive or dominant) and revising those models to explain new, unfamiliar modes.

Students do what scientists do

Students in Johnson's class begin by studying Gregor Mendel's basic model of inheritance. They read Mendel's explanation of the simple dominance mode of inheritance. Mendel "himself" (often played by a graduate student) visits the class to help them recreate his model. With Mendel, they look at the flower structure of the pea plants he used in his famous experiments. Together they count and classify peas previously gathered from three generations of plants to see how different traits, such as color or shape of seed, pass from one generation to another.

Student research groups are then provided, via a computer simulation, with random collections of hypothetical organisms that follow the simple dominance model. Over several days the students become more familiar with the model by producing generations of organisms from the random collections. They determine which variation of a particular trait is dominant and which recessive. They match genotypes (genetic makeup) to phenotypes



Johnson



The pros and cons of “holding out”

“Five-year-old boys with summer birthdays are rarely ready for kindergarten – they should spend another year at home or in nursery school.”

You often hear that statement. But the suggestion is unsubstantiated by research, according to UW–Madison Education Professor Elizabeth Graue and Lehigh University’s James DiPerna.

Their recent study challenges conventional wisdom about the value of redshirting and early retention. In fact, some children who are “held out” miss receiving needed attention in areas of learning disabilities, cognitive disabilities, and emotional disabilities. Until we know more, Graue says, redshirting and early retention should not be widely promoted or endorsed.

Graue and DiPerna collected data from a representative stratified random sample of the 367 Wisconsin school districts with elementary schools. The stratification characteristic was socioeconomic status represented by the proportion of students eligible for the federal free and reduced lunch program. Graue and DiPerna examined the school records of more than 8,500 Wisconsin students in 47 districts to depict patterns of school entry, promotion, subsequent special services, and student achievement.

Holding children out, also called academic redshirting, is a popular idea. The name comes from the term used in athletics. High school and college athletes are redshirted when their participation in sports is delayed to make them more competitive by providing an additional year of growth and maturation. Kindergartners are redshirted when parents delay entry because of concerns about readiness for school. Approximately 7% of kindergartners in the Wisconsin sample were redshirted and 3% retained K–3 in 1995.

The majority of redshirts are boys with summer birthdays (in states with fall kindergarten cutoffs). Retainees (students who are asked to repeat a grade) follow this pattern with the addition that children of color and of poverty are overrepresented. These proportions and patterns hold true in nationally representative samples.

Graue and DiPerna found that students do not seem to benefit socially from being redshirted. Their self-concept and acceptance by peers are about the same, as are teacher ratings of behavior for oldest (redshirted) and youngest (not redshirted) children. In fact, retrospective and cross-sectional analyses show redshirts doing *less well* than their peers on measures of behavior problems, Graue says. Although it is not argued that redshirt-



When communities embrace “academic redshirting,” parents feel pressure to redshirt younger boys even when they are ready for school.

ing has *caused* increased rates of social and emotional difficulty, it does not appear to *solve* social or emotional problems.

Graying of kindergarten

Because academic redshirting occurs before formal schooling begins it is not subject to the stigma attached to retention or transitional grades. But the practice has resulted in a “graying of the kindergarten.” Students in kindergarten classes are increasingly likely to be six years old, bringing with them the skills and expectations that another year of life experience provides. Once redshirted children arrive at school, parents often request a more advanced curriculum for their redshirted 6-year-old kindergartners.

When communities embrace redshirting, parents feel pressure to redshirt younger boys even when they are ready for school. To avoid the stress of considering delay of school entry, parents have reported *timing the conception of their child* with redshirting in mind.

Some believe redshirting will head off the need for extra support because the additional year of growth will move children to the top of their class. If these expectations are accurate, one would expect redshirted students to need fewer supplemental educational programs than comparable stu-

continued on page 8



Graue

Study sheds new light on board certification

Some of the best and brightest teachers further their careers and broaden their skills by pursuing certification from the National Board of Professional Teaching Standards. A recent study by UW–Madison Education Professor Carolyn Kelley and doctoral student Steven Kimball found that the Board certification process had a significant beneficial effect. Teachers achieving Board certification gained confidence in their teaching abilities, honed teaching skills, and gained significant opportunities for exercising leadership in their districts, states, and the profession. The study also found, however, that the effects of Board certification have not yet had a major influence on the broader professional school community.

Conducted by WCER's Consortium for Policy Research in Education (CPRE), the study examined the effects of Board certification on teacher, school, and district functioning and examined the effects of linking pay to Board certification.

The sites researched in Kelley and Kimball's study included two urban districts with an average of 47,000 students, a rural district enrolling about 900 students, a small city district with about 8,500 students, and a small town district with about 2,000 students. Kelley notes that, as in any qualitative study of this nature, the findings are not generalizable beyond the population studied. However, the information can provide insight into the processes and experiences of these teachers and districts and can provide information to ground future work.

A new paradigm

For the last 50 years the single-salary schedule has been the bedrock of the teacher compensation system, Kelley says. This system rewards teachers for years of experience and the accumulation of credits and degrees. But policymakers are now looking for ways to better link the salary schedule to the development of the specific knowledge and skills needed to achieve educational goals and quality teaching as defined by the district, the state, and/or the profession. The CPRE study examined the growing practice of knowledge- and skill-based pay (KSBP) and, in particular, the most common knowledge- and skill-based pay innovation, pay bonuses for teachers certified by the NBPTS. Kelley says two factors make KSBP powerful:

1. Its focus on teacher quality highlights the importance of better using available resources, such as pay, to focus and enhance teacher learning throughout the teaching career.

2. The development of the NBPTS, the work of the Interstate New Teacher Assessment and Support Consortium (INTASC), the Praxis assessment series, and the Charlotte Danielson Framework rubrics (1996) have produced widely accepted measures of teacher performance that are being used as the foundation for a pay system linked to teacher knowledge and skills.

In theory, KSBP contributes to the improvement of student learning directly by enhancing teacher knowledge and skills. It contributes indirectly by creating a shared vision of the effective instruction that focuses and shapes teacher professional development and by promoting professional learning communities within schools, in which teachers can share knowledge, skills, and problems of practice.

Incentives for participating

The CPRE study found that many teachers sought Board certification because they wanted to affirm or confirm that they were accomplished teachers. Others spoke of certification as a personal challenge and a next step after pursuing a master's degree—a form of professional growth and development. Candidates also spoke about the desire for career advancement within teaching and opening doors for careers in administration or leadership. Most of the teachers mentioned that a combination of factors led them to pursue certification.

The use of monetary awards by states and districts appears to be having substantial effects in attracting teachers to consider pursuing Board certification. Monetary awards signal policymaker and administrator support. As examples, Wisconsin offers a \$500 one-time bonus, Idaho offers a salary supplement of \$2,000 per year over five years, Louisiana offers a \$5,000 annual increase over ten years, and Nevada offers a one-time 5 percent salary increase.

Kelley says further research is needed to understand the effects of monetary incentives on Board certification beyond the five districts studied. Currently, 30 states and a large number of districts attach salary incentives to Board certification.

Benefits of participating

The study revealed general agreement among principals and Board-certified teachers that the certification process is beneficial. An official in one of the urban districts studied asserted that "Every one of those hurdles has real application, later, and



Kelley



that's a big difference between just getting a certificate or a degree (and getting National Board certification)."

Teachers said the NBPTS certification process helped their practice and caused them to reflect more deeply into their instructional strategies and student learning. Although it was difficult for the teachers and principals to quantify improvements in student achievement linked to certification, there were indications that these teachers were some of the best in their school and that their students performed well. According to one principal, "It would stand to reason that when a teacher is better able to meet the needs of students in that classroom, those students are going to be able to excel. (The NBC teacher) does that. She meets the needs of her kids."

The certification process helped teachers to be more purposive. Teachers were confident and competent in their abilities before they attempted Board certification and strengthened these attributes through successful completion.

Implications for professional community

In theory, when a school has a critical mass of Board certified teachers, these teachers begin to assume leadership roles in the development of evaluation systems, professional development opportunities, and other aspects of human resource management. Board certification can begin to penetrate organizational goals and contribute to teacher collaboration and professional discussion. But in the districts Kelley and Kimball studied, even those with relatively large numbers of Board certified teachers, the effects of Board certification were largely limited to the classrooms of the Board certified teachers. In four of the five districts studied, Board certification had not yet penetrated schools' internal accountability systems or deeply affected the broader professional school community. Kelley says maybe that's because NBPTS certification is externally defined by the profession. It may take more time, and more Board-certified teachers taking on leadership positions in schools and districts, to have an effect on the individual school organization. The study found that Board certification is likely to have a broader impact on noncertified teachers when district administrators embrace Board certification goals and when teachers have access to a variety of challenging, excellent individual professional development opportunities.

Teachers in this study considered their engagement in activities outside the classroom (for example, participating in district, state, and national



Board-certified teachers appear to be connecting with other certified teachers through professional networks.

committees) both as a valued opportunity and as a responsibility. Districts that strongly support Board certification were more likely to use certification as a key factor in selecting teachers for leadership positions in the district. Although collegial interaction in the process of Board certification and following certification was not very evident at the schools in this study, certified teachers do appear to be connecting with other certified teachers through professional networks and with district and state officials. Board-certified teachers had significant ongoing professional connections outside the school or district that they attributed to the certification process.

Funding for this study was provided by the Pew Charitable Trusts and the Office of Educational Research and Improvement, U.S. Department of Education. For more information visit the WCER's CPRE web site at www.wcer.wisc.edu/cpre/teachercomp/tchrcomp/teachercomp.HTM or contact Carolyn Kelley at kelley@education.wisc.edu.

About the NBPTS

The NBPTS is a teacher-led national standards board whose goal is to advance the profession by defining, assessing, and shaping teaching excellence. NBPTS focuses on standards and assessments. Based on the standards established for each teaching specialization, teachers pursuing Board certification demonstrate their knowledge and skills through a portfolio of performance-based activities, including documentation of student work, reflective writing, videotapes, and analysis of classroom teaching and student learning. Assessment is carried out through review of submitted portfolios and written performance on assessment center exercises.

Teacher research spurs professional development

Teacher research can be a professional development experience of great importance and have a significant effect on teaching and learning, according to UW Madison Education Professor Kenneth Zeichner. His recent meta-analysis of studies of teacher-research activities nationwide* shows teacher-researchers gaining a new sense of confidence from conducting research, beginning to see themselves as learners, and developing closer relationships with their students and colleagues.

Teacher research involves teachers directly in the selection of immediate and compelling topics to explore with respect to their own practice.

"Teacher-researchers are autonomous, responsible agents who direct their own work and their own professional development," Zeichner says.



Teachers engage in action research because they see its relevance to their work.

Kinds of research programs

Depending on the program, teachers' individual studies range in format and content. Many teachers write journals documenting their research experience or find some other way to keep detailed records of

their observations of and discussions with students. These records help teachers challenge the way they think about their teaching.

Other kinds of teacher research include ongoing discussions of practice; data analysis of observations, interviews, and document collection; and written essays that interpret and analyze various aspects of schooling. Some teacher research involves posing and investigating a specific question, while other projects focus simultaneously on several questions. While some research projects primarily attempt to develop a better understanding of practice, others also aim to improve it. Some studies focus on specific classroom issues, while others move beyond the classroom to issues that are schoolwide or larger.

The degree to which "outside" research is incorporated into the teachers' studies varies widely. For example, in Brookline, Mass., some teacher-researchers used concepts, questions, and ideas from external research as the starting point for their own

research; others used external research as a resource later on in the research process; and some chose not to use external research.

The many benefits

Although there is a growing amount of testimony about the positive outcomes of this kind of research, Zeichner says one should not draw immediate conclusions about its value from this testimony alone. For example, many of the claims about the value of teacher research are anecdotal in nature rather than the result of systematic studies of teachers' research experiences. And even if the accuracy of the claims is accepted, there is little information about how the research is conducted or supported, making it hard to know how to replicate these successes. Yet in spite of these concerns, teacher researchers forge ahead. Zeichner says teachers engage in this kind of research because they see its relevance to their work and because they seek to better understand, or change, their classroom practice. Advocates claim that teacher research

- ▶ helps teachers become more flexible and open to new ideas,
- ▶ narrows the gap between teachers' aspirations and realizations, and
- ▶ heightens the quality of student learning.

Teachers are motivated to conduct research in their own classrooms for a variety of reasons. They include

- ▶ the desire to know more about student learning. Teachers in the Madison (Wis.) Metropolitan School District's Action Research Program report becoming more learner-centered in their practice as a result of conducting research. Many developed a new appreciation for the knowledge their students bring to class. In some cases there is evidence that this increased effort to listen to students leads to more democratic and interactive work in the classroom.
- ▶ a search for connections and meaning in one's work. Participants in the Teacher Study Groups at the Lawrence School in Brookline, Mass., critically examine, explore, and affirm their work, placing teacher knowledge at the center of the inquiry process. Teachers' perspective broadens as they question their assumptions about themselves and their students and develop new perspectives toward teaching and learning. Changes in perspective lead to changes in teachers' professional identities as they learn to more clearly articulate their ideas about education.



Effects on school culture

Unlike many other professional development experiences, teacher research promotes particular kinds of teacher and student learning that many teachers find valuable. The evidence from recent reports shows that, under the right conditions (see below), engaging in teacher research validates the importance of the work teachers do and helps them to

- ▶ become more confident about their ability to promote student learning,
- ▶ become more proactive in dealing with difficult situations arising in their teaching,
- ▶ acquire habits and skills of inquiry used beyond the research experience to analyze their teaching, and
- ▶ develop or rekindle an excitement about teaching.

Zeichner also sees evidence of links between conducting teacher research under particular conditions and improvements in students' attitudes, behavior, and learning, although he says these improved student outcomes have not always been reported in sufficient detail.

The right conditions

From his studies of teacher research programs nationwide, Zeichner has condensed a set of attributes that appear to be important in transforming teacher and student learning.

- ▶ Creating a culture of inquiry that respects the voices of teachers and the knowledge they bring to the research experience. Educators should consider teacher research as seriously as other kinds of inquiry and should evaluate it on the basis of both moral and educational criteria.
- ▶ Investment in teachers' intellectual capital, which results in teachers having control over more aspects of the research process. When teachers lacked the ability to determine their own research focus, they reacted negatively to what they saw as an administrative attempt to increase controls over them.
- ▶ Collaboration over time in a safe and supportive group environment. Working in a group where all members are engaged in self-study seems to help teachers develop new dispositions and skills to work collaboratively.
- ▶ Intellectual challenges and stimulation. Teacher researchers said they valued the difficulty and challenges provided by group discussions about their work.
- ▶ Established rituals and routines that build community within groups. Studies of programs in Wisconsin and Massachusetts have provided important information about the ways facilitators of local research groups structure group

discussions about the research process (e.g., determining several possible data collection tools) and group discussion norms (e.g., posing clarifying questions). Sponsors of teacher research range from teachers themselves, to school districts and teachers' unions, to state departments of education and foundations. Some universities and colleges offer specific courses on teacher research, support teacher research graduate work, and organize and support teacher research on a broad scale.

Making a commitment to teacher research as professional development represents a long term investment in building teachers' capacity to exercise their judgment and leadership abilities and to improve learning for themselves and their students. It is not a form of professional development that will produce quick fixes for the complex and ongoing problems of schooling, Zeichner says. Nor will it compensate for the unsatisfactory working conditions teachers must often endure, or the failure of our society to provide the social preconditions necessary for the educational success of all students. But when teacher research is organized and supported it can become an experience of great importance to teachers and have a clear impact on teaching and learning.

For more information contact Zeichner at zeichner@facstaff.wisc.edu. Copies of his recent report, cowritten with Mary Klehr, *Teacher Research as Professional Development for P-12 Educators*, also are available from him. Funding for the study was provided by the Office of Educational Research and Improvement, U.S. Department of Education.

For additional information on teacher research. The Web site for the National Partnership for Excellence and Accountability in Teaching (NPEAT) is www.npeat.org. The Web site for the National Commission on Teaching and America's Future (NCTAF) is www.tc.columbia.edu/~teachcomm/, which includes the report "What Matters Most: Teaching For America's Future" (The National Commission on Teaching and America's Future, 1996), a blueprint for recruiting, preparing, and supporting excellent teachers in all of America's schools, and teacher research is part of the vision.

FOOTNOTE:

*The five programs reviewed for the Zeichner/Klehr study include the Madison (Wis.) Metropolitan School District classroom action research program; Brookline and Boston (Mass.) Learning/Teaching Collaborative inquiry seminars; the Lawrence School teacher study groups, Brookline (Mass.); the Bay Area (Cal.) professional development consortium teacher action research project; and schoolwide action research in Georgia and Ames, Iowa.



Zeichner



Klehr



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WCER Highlights is published by the Wisconsin Center for Education Research, School of Education, University of Wisconsin–Madison.

WCER is funded through a variety of federal, state and private sources, including the U.S. Department of Education, the National Science Foundation, and UW–Madison. The opinions expressed in this publication do not necessarily reflect the position, policy, or endorsement of the funding agencies. Fourth-class, bulk-rate postage is paid at UW–Madison, Madison, WI. Send changes of address to WCER, 1025 West Johnson Street, Madison, WI 53706 or call (608) 263–4200. Include the address label from this issue.

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ISSN 1073–1822
Vol. 11, No. 4
Winter 1999–2000

Science

continued from page 1

Rather than acting primarily as a disseminator of information, Johnson acts as a laboratory director, giving encouragement when it is needed and asking the student researchers: "What anomalies have you encountered? How does your proposed model explain this cross? What strategies have you used to test your model?"

She finds the new role refreshing but challenging. Could more teachers teach this way if they wanted to? Johnson says, "It's a different way of thinking about the teacher's role in the classroom, but most teachers could adapt, especially if they could have some experience with this new role. Those who like a very structured and predictable classroom might feel a little less comfortable."

Johnson's course was developed in collaboration with her peers in WCER's National Center for Improving Student Learning and Achievement in mathematics and science. Funding for her research was provided by the Office of Educational Research and Improvement, U.S. Department of Education.

For more information, see the NCISLA web site at <http://www.wcer.wisc.edu/NCISLA>, or contact Johnson at skjohnso@facstaff.wisc.edu.

Graue

continued from page 3

dents who had made normal entry and enrollment progress. But Graue's study does not support this view. All groups who are overage-for-grade, whether they have been redshirted or retained, have *higher* participation in special education services for learning disabilities, cognitive disabilities, and emotional disabilities. In fact, delaying entry or promotion was associated with higher likelihood of exceptional educational needs (EEN) services, with redshirts being 1.89 times more likely to participate in EEN programs.

Graue compared achievement of various entry and promotion groups on the Wisconsin Third Grade Reading Test and found that all groups are statistically and practically even in their test results, with the exception of students who were retained during early elementary years. Redshirts achieve on par with their grade-level peers, including summer birthday children who entered on time (though they are not on top as some would suggest). All retainees performed at levels below their grade-level peers. Retention does not close the gap for children who experience early school failure.

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