College-level teaching is more complex and nuanced than ever, and simple descriptors such as “lecturing” or “interactive” don’t tell us much.

Reducing how an instructor teaches Biology 101 to a variable such as “lecturing” masks other important dimensions of her teaching. What kind of questions does she ask students? How often? How are students socially and cognitively engaged in the classroom? How is technology used?

Those who evaluate classroom teaching can record their observations using a number of tools, but most are limited: They rely on open-ended response items that preclude reliability tests or comparison across individuals; they focus only on the use of teaching methods; they ignore temporary fluctuations in teaching practices throughout a class period; or they equate instructional quality with one teaching method.

WCER researcher Matthew Hora says developing a more nuanced and detailed knowledge of college teaching styles will help determine what is most likely to benefit student achievement. In a recent study Hora and colleague Joseph Ferrare used a tool called the Teaching Dimensions Observation Protocol (TDOP). http://tdop.wceruw.org/

Based on an instrument WCER researcher Eric Osthoff developed for studying middle school science teaching, the TDOP captures subtle and dynamic realities of classroom practice that an exclusive focus on teaching methods would miss. Hora and Ferrare used TDOP to evaluate the teaching of 58 math and science faculty in classrooms at three public research universities.

It’s Time to Document Teaching Styles More Carefully

Discussions of college classroom teaching styles often categorize them as either “lecture” or “interactive.” But those terms do not reflect the realities of classroom practice.
Student achievement in K-12 grades is compromised by stereotypes and by high rates of mobility, among other things, and this issue of Research Highlights addresses both subjects.

The academic achievement of African American and Hispanic students continues to trail that of their White peers. “Stereotype threat” undermines the performance of negatively stereotyped persons, even though they may not be aware of it. A recent study finds that self-affirmation writing exercises improved the achievement, especially in mathematics, of students who may suffer from stereotype threat.

Students who move from school to school often have lower test score gains in reading and mathematics, lower self-esteem, trouble fitting into school, and higher dropout rates. High student turnover also can hinder school reform efforts, as it is difficult to sustain progress with transient students. Another recent WCER study finds that schools can reduce mobility for some students and increase their odds of success by improving their social and academic climates and by boosting students’ and families’ sense of membership in the school.

In this issue we also read about mathematics teachers who use gestures to communicate mathematical concepts more effectively. Students often find it challenging to understand the relationships that link, and give meaning, to, mathematical ideas. One research team finds that when teachers act out, or embody, such links, they help students integrate multiple ideas.

Once students reach college, they’ll find that teaching practices have become more complex and nuanced than ever. Simple descriptors such as “lecturing” or “interactive” don’t tell us much. Recent research describes how to develop a more nuanced and detailed knowledge of college teaching practices to inform practice and professional development: The Teaching Dimensions Observation Protocol captures five dimensions of college-level teaching practice.

WCER marks its 50th anniversary this year. We plan a number of activities and publications to celebrate the event, and to renew our commitment to improving teaching and learning for all students of all ages.

FROM THE DIRECTOR

Robert Mathieu

Self-Affirmation Exercises Found To Boost Some Achievement Leaders

The academic achievement of African American and Hispanic students continues to trail that of their White peers. The concept of “stereotype threat” is one of many contributors to explaining these achievement gaps and offers an avenue to intervene and narrow them.

UW–Madison education professor Geoffrey Borman says this phenomenon undermines the performance of negatively stereotyped persons, such as African Americans and Hispanics in all academic subjects, or women in mathematics. Students who are aware that they belong to a group perceived to perform poorly academically often fear behaving in a way that fits the negative cultural image associated with a group stereotype. This fear is largely unconscious, but it elicits anxiety and other counterproductive responses that can interfere with students’ thinking and performance on standardized tests.

Underperformance due to stereotype threat may lead students to alter their career aspirations. It may challenge their sense of belonging in school. It may lead them to “protectively dis-identify” from academics.

Self-affirmation exercises have been found to help students productively cope with stereotype threat by bolstering other dimensions of their self-worth. Students can compensate in one area—values—for a deficit in another—group identity—and thereby maintain a positive overall sense of themselves.

Expressive writing, in which students write about things that are important to them, is the most commonly used approach to engage in values affirmation, especially among large groups of students. How might a series of writing exercises lead to substantial changes in academic performance? Borman and colleagues found that writing helps students gain relatively “quick wins.” As these accumulate in a recursive process, like a chain reaction, the gains are carried forward.

Borman’s evaluation was the first districtwide study of a values-affirmation writing intervention. He conducted the study in Wisconsin, where the academic achievement gaps between Whites and Blacks, and Whites and Hispanics, are among the largest in the United States, according to data from the National Assessment of Educational Progress. He conducted the study in all the middle schools in one school district, making it the most expansive test of such an
Self-affirmation writing exercises improved the achievement, especially in mathematics, of students who may suffer from stereotype threat.

intervention among secondary students to date. The study tracked students’ GPA and examined the potential impacts of self-affirmation on standardized achievement tests administered at the beginning and end of the school year.

The analysis contrasted two groups of students: those who are potentially subject to stereotype threat (the affirmation group) and those who are not (the comparison group). The students completed four writing exercises over the course of one school year.

The first two exercises asked students in the affirmation group to choose, from a list, two or three items that were most important to them. The comparison students were offered an identical list, but they were asked to identify the two or three items they considered least important, and to write about how they might be important to someone else. Both exercises included follow-up questions to reinforce student reflection.

Students in the affirmation condition then were asked to describe something important to them, while students in the comparison condition were asked to describe what they did that day before school.

The fourth exercise was administered later on in the school year and tailored to the affirmation student based on his or her choices in the first and second exercises. It asked the student to reflect on an item chosen earlier and describe how it is important to him or her. Students in the comparison condition wrote an expository essay describing what they do after the school day ends.

Shortly after the second writing exercise, students took the state reading and mathematics tests, the Wisconsin Knowledge and Concepts Examination (WKCE). Borman found no evidence of an impact of the self-affirmation exercise on students’ reading test scores. The mathematics outcome, however, differed: Students identified as potentially subject to stereotype threat and assigned to the affirmation condition scored higher in the mathematics section of the WKCE than students assigned to the comparison condition.

The researchers then evaluated the potential impacts of self-affirmation for students who may be vulnerable to stereotype threat on the spring Measures of Academic Progress (MAP) test. As with the fall WKCE reading test, there was no evidence of an impact on reading. However, the self-affirmation writing exercises positively influenced the scores of stereotype-threat-vulnerable students in writing and grammar, or language usage. There also was strong evidence of a treatment impact on spring MAP scores in mathematics, with students assigned to the self-affirmation condition scoring higher than the condition group.

Borman cautions that self-affirmation writing does not plausibly develop mathematics ability, but there are reasons why self-affirmation might impact math achievement and not reading. First, taking a mathematics test is perhaps more stressful for students. Stress compounds the self-monitoring and other harmful processes that stereotype threat induces in vulnerable students. If mathematics tests are more threatening than reading tests for seventh grade students, then self-affirmation is more likely to help students demonstrate their abilities in mathematics than in reading.

Second, other research provides evidence that mathematics performance is more responsive to school inputs than reading. That's perhaps because students have alternative venues for learning to read (e.g., the family).

Borman says the overall impacts of the self-affirmation exercise represent about a 28% improvement over the annual achievement gain otherwise expected for seventh graders. If the results from this intervention can be replicated and better understood, Borman says, it holds tremendous potential for closing persistent achievement gaps both in Wisconsin and the nation.
TDOP captures five dimensions of teaching practice: teaching methods, pedagogical strategies, student-teacher interactions, cognitive engagement, and use of instructional technology. Besides recording observable teaching methods such as lecturing or small group work, TDOP records instructors’ use of strategies such as humor, illustrations or anecdotes, and verbal transitions between topics. TDOP documents student-instructor dialogue and student-focused instruction. And TDOP captures how faculty use smart boards, digital slides, clicker response systems, and demonstration equipment.

Using TDOP, observers record classroom events in 5-minute intervals. Multidimensional graphs can be constructed that capture the teaching behaviors of each instructor across the five dimensions, and then compared across individuals or groups. Figure 1 compares the teaching activities of two biology instructors.

One lecturer supplemented PowerPoint slides with a relatively small range of additional behaviors including illustrations and anecdotes, humor, conceptual questions, and multimedia, which were then associated with one type of potential student cognitive engagement (i.e., recall and memorize information). In contrast, the other instructor used five forms of lecturing, instructional technologies associated with a variety of cognitive engagements, and student interactions.

The two network graphs shown in Figure 1 illustrate that, although both instructors lecture for most of the class, each used a different repertoire of teaching behaviors to convey the course material to students.

Hora says descriptive research about postsecondary science teaching is important in the same way that careful observations of phenomena are central to the scientific method. Detailed descriptions of teaching, such as those obtained with the TDOP instrument, can be useful in three ways, Hora says.

- **TDOP can inform faculty professional development sessions.** When incorporated into formal professional development efforts, such as new faculty orientations, these accounts can spark self-reflection for individual faculty and help faculty developers gauge an individual’s growth over time.

- **TDOP provides more accurate accounts of classroom teaching for policy makers.** Policy makers often encourage faculty to set aside lecturing in favor of interactive teaching methods. In doing so, however, they oversimplify the problem. With more accurate descriptions of teaching, policy makers can target scarce resources toward programs that align research-based practices with practice.

Hora notes that TDOP could also explore the relationship between classroom teaching and student learning. His study did not aim to determine how different types of instruction influence how students studied and ultimately learned the course material, but he recommends that future research should include this dimension.
An afterschool program for children and families was found to substantially reduce the school mobility of Black students who otherwise were especially likely to change schools. Improved relationships among families help explain this finding.

High rates of student mobility pose serious problems for students and for schools. Students who move from school to school often have lower test score gains in reading and mathematics, lower self-esteem, trouble fitting into school, and higher dropout rates. High student turnover also can result in problems within the family and hinder school reform efforts, as it is difficult to sustain progress with transient students.

Black and Hispanic students are more likely to change schools than White and Asian American students, due in part to economic disadvantage. Their frequent moves lead to an increased risk of underachievement in school. Immigrant students and English language learners have above-average mobility rates as well, which results in it taking longer for them to achieve English proficiency.

A recent study by Jeremy Fiel, Anna Haskins, and Ruth Lopez Turley focused on mobility between first and third grades in 52 predominantly low-income and Hispanic schools. They chose Phoenix because Arizona saw more than a quarter of all students change schools at least once between 2004 and 2008. Mobility rates were highest among elementary students. They chose San Antonio because Texas saw one-third of public school students move at least once between fourth and seventh grade (not including moves related to the transition from elementary to middle schools). School mobility was higher among Black and White students than Hispanic students, and it was higher among students who qualified for free or reduced-price lunch.

The study found that schools can reduce mobility for some students and increase their odds of success by improving their social and academic climates and by boosting students and families’ sense of membership in the school.

The study examined the effects of an afterschool program developed at the University of Wisconsin–Madison. Families and Schools Together (FAST) is an intensive 8-week program that empowers families and promotes child resilience. It increases the relations of trust and shared expectations within and between families, and among parents and school personnel.

During 8 weekly sessions, families come to the school to participate in communication and bonding games, eat meals prepared by each of the families, engage in parent social support groups and child-directed play therapy, and perform ceremonies that model family rituals.

The study found that FAST substantially reduced school mobility for Black students. Those Black students not receiving FAST intervention were more likely to move (53%) than not, but in FAST schools their probability of moving was much lower (38%). Students who lived farther from their schools were more likely to change schools than others, but this association

(continued on page 7...)
Gestures Enhance Student Understanding of Math

A deep understanding of mathematics requires not only learning individual concepts but also the relationships among them. Although these relationships are essential, they are often challenging for students to understand.

UW–Madison education professors Martha Alibali, Mitchell Nathan, and Eric Knuth study how teachers use gestures to communicate links among mathematical ideas. Their goal is to pinpoint the most effective use of gestures so as to enhance teacher effectiveness.

Alibali and colleagues recently observed six middle school math teachers from a midsized Midwestern city. They watched the teachers use different expressions to describe and link ideas. Besides speech, teachers used gestures, writing, drawing, and actions on math manipulatives. Teachers predominantly produced “multimodal” links: speech and gesture, or speech and writing and/or drawing, or a combination of all these. Gesturing to make links happened more than 10 times per hour of instruction in the middle school lessons observed.

Alibali uses the term linking episode to describe these segments of instruction. In some linking episodes a teacher made a general link between two ideas and then supported that by connecting specific components of the two ideas. For example, one teacher explained how to read a table of values. She first made a general link between two columns in the table, and then elaborated by connecting individual cells in the two columns for analysis.

Teachers made multimodal links most consistently when the content of the link was mentioned for the first time in that lesson. Thus they were sensitive to the state of students’ knowledge and appeared to communicate multimodally when students needed it most.

Teachers also used gesture-rich communication to avoid anticipated breakdowns in students’ comprehension or to address trouble spots in instruction. When recognizing that students may lack sufficient common ground with the teacher to understand a new idea, teachers used gestures to help give meaning to the new idea (see Figures 1 and 2).

Teachers sometimes used simultaneous gestures to link ideas, for example, by pointing to two things at the same time. They referred to both of the linked ideas and demonstrated the linking relationship all at once. In so doing, they seemed to draw students’ attention to both of the individual ideas and to their relationship at the same time.

Simultaneous gestures to link related ideas seemed to benefit student learning. The research team videotaped a teacher instructing small groups of students both before and after a professional development tutorial that encouraged the teacher to use simultaneous gestures to link related ideas.

Mathematics teachers communicate concepts and also the links among those concepts. During instruction, teachers sometimes use pointing gestures to index objects and locations in the physical world. Teachers use depictive gestures to simulate actions and perceptions. For example, when talking about fractions as part of a pie, a teacher might produce a series of cutting motions.

Figure 1. A linking episode using both speech and gesture: The teacher says, “The exponent matches the year” while first pointing to the exponent column and then to the years column.

Figure 2. A teacher uses simultaneous gestures to link ideas.
Students learn many mathematical ideas through their links to other, related mathematical ideas. Some links involve connections among ideas at elementary levels. For example, the slope of a line in a graph may gain meaning via its relation to the slope of a line in a different graph.

Other links involve connections within one mathematical representation. For example, a point on a graph gains meaning through its relations to other components of the graph, such as the axes and the origin.

Some links involve connections among different mathematical representations. For example, the linear function \( f(x) = ax + b \) gains meaning through linking this symbolic representation to its graphical representation.

The researchers chose to study middle school because instruction at that level focuses on connections among ideas or among different representations of mathematical information.

The teacher altered his gestures after the tutorial, producing many more simultaneous linking gestures. Students who viewed the gesture-enhanced video lesson performed better on a posttest than did students who watched the baseline video.

Alibali hypothesizes that the physical manifestation of connections that linking gestures embody may make it easier for students to attend to, and integrate across, multiple ideas, compared to the unfolding of sequential gestures.

Knowledge about the effects of teachers’ gestures on students’ learning is not yet complete, so Alibali and colleagues cannot offer definitive, empirically based recommendations about practice.

However, these preliminary findings offer tentative implications for teacher practice and professional development. Teachers have a readily available way to help students understand connections—right at their fingertips.

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was significantly weaker in FAST schools. Turley says it’s plausible that children who lived farther away from school were more mobile because their families were less connected with the families at their child’s school, but FAST helped incorporate them into school networks and communities, making them less likely to move.

School mobility is an important outcome to be studied in its own right, Turley says, and little published research has examined efforts to curtail mobility or to moderate its negative consequences. This study provides evidence that building relationships between and among families and schools may significantly reduce mobility for Black students in predominantly Hispanic schools.