Non-elite public institutions have absorbed the rapid expansion of higher education during the last 50 years. Studies suggest that declining institutional resources at these schools have diluted the quality of the college experience for a broad swath of U.S. students, dragging down completion rates. Dramatic increases in public enrollment, unaccompanied by corresponding increases in funding, have contributed to declines in college quality.

Less than 60% of students now entering 4-year institutions earn bachelor’s degrees. Barely one-fourth of community college students complete either associate’s or bachelor’s degrees within 6 years of college entry. Students from economically disadvantaged families are even less likely to realize their college ambitions. Only 40% of beginning college students from low-income families complete a 2- or 4-year degree within 6 years, compared with 62% of high-income students. Since future economic and social success largely depends on holding a college degree, this low rate of college completion among the poorest students perpetuates growth in income inequality.

UW-Madison education professor Sara Goldrick-Rab and colleague Josipa Roksa call for a partnership among the federal government, states, and institutions of higher education. The collaboration would work to prepare, inform, encourage, educate, and finance all potential college graduates across the entire span of schooling, from preschool through college.

Goldrick-Rab says that many federal policymakers operate under the false assumption that after students gain college admission, a degree is guaranteed. But Goldrick-Rab and Roksa found that the reality involves stagnating completion rates, increased time to degree completion, and persistent disparities in attainment by family income level. Their report, *A Federal Agenda for Promoting Student Success and Degree Completion* (Center for American Progress, WINTER 2008-09 Vol. 20, No. 2).
The proportion of young people enrolling in college has grown since the 1970s, but the proportion receiving diplomas has stagnated. An examination of bachelor's degree completion rates within 8 years of high school graduation reveals that barely half of the high school cohort finished a degree in both 1972 and 1992. Stagnation was accompanied by delays in completion of the bachelor's degree. Among students starting at “4-year” institutions, only 34% finish a BA in 4 years, 64% within 6 years, and 69% within 8.5 years. (Goldrick-Rab and Roksa, August 2008), elaborates on areas where policymakers could most effectively intervene to reverse these trends and details the factors contributing to student success.

Goldrick-Rab and Roksa argue that the federal government should support states and public colleges and universities as they work to help more college students complete their education. That support would require increased investments in the most accessible but under-resourced schools. Efforts should address:

- lowering the financial barriers to college completion,
- improving students’ chances of experiencing academic success in college,
- streamlining the transfer of students and credits across schools to broaden access and increase efficiency, and
- ensuring the value of degrees by emphasizing and measuring individual learning and achievement.

Increased federal involvement could help guarantee not only that necessary funding is provided, but also that clear messages are communicated and data are collected so that progress can be measured. National leaders can turn more dreams into college diplomas, says Goldrick-Rab, by working with educators, state legislators, and families.

The 20th century witnessed a massive general expansion of opportunities for access to higher education. Yet children’s socioeconomic background has been a consistently strong predictor of their odds of college completion. The implications of existing disparities trouble Goldrick-Rab. For one thing, educational attainment has a strong connection to labor market rewards. Completion also is associated with a range of other important outcomes, including health, family stability, and general well-being. Federal policymakers must also come to grips with this difficult reality, she says. The goal is to increase the production of college credentials of value, while decreasing inequalities in who receives those credentials.


Adam Gamoran
WCER Director
Professor, Sociology and Educational Policy Studies

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Professor, Curriculum and Instruction

FROM THE DIRECTOR

In this issue of WCER Research Highlights you’ll read stories about mathematics education, science education, principals' practice, and policies for improving students’ college completion rates.

As of January, I am filling in as interim Dean of the School of Education while current dean Julie Underwood serves as interim university Provost.

Beth Graue is serving as interim WCER director. Beth is a professor of curriculum and instruction and WCER’s director of graduate training.

For the next several months I’ll work to continue advancing the School of Education’s priorities, including reorganizing the school’s outreach, partnerships, and technology services; renovating the Education building on Bascom Hill; and planning for a new Art building.

Adam Gamoran
WCER Director
Professor, Sociology and Educational Policy Studies
What Influences Principal Practice?

Given the demands placed on school principals, it can be difficult for them to focus on one aspect of their work for very long. The job involves multiple, competing demands and responsibilities. Parent and teacher meetings, calls from the central office, and external mandates often require principals to allocate their time in fairly thin slices.

Some principals are generalists. They devote significant portions of time to all kinds of activities. Others choose to focus on one area—for example, instruction. Research by UW-Madison education professor Eric Camburn and colleagues found that a principal’s choice of focus depends primarily on the school context, to a lesser degree on personal attributes, and on the interaction between the two.

Camburn recently examined three aspects of principals’ priorities and practice:

- The way in which principals allocate their attention across major areas of responsibility;
- The extent to which principals emphasize different areas of responsibility in different contexts; and
- The extent to which personal, individual attributes affect how principals allocate their time and attention.

Camburn’s study found that contextual conditions distinguished among the three types of principals to a much greater extent than personal, individual characteristics. He used five measures to examine contextual conditions: the number of students in the school, the percentage of disadvantaged students, teachers’ average number of years teaching, the level of emphasis on academic excellence (academic press), and the level of student engagement.

The study found that eclectic principals differ significantly from those who have either a student or an instructional focus. Eclectic principals tend to operate in schools with higher academic press, higher student engagement, and lower percentages of disadvantaged students. They are most likely to work in elementary schools and medium-sized schools. Their freedom to spend time on varied activities and leadership responsibilities may reflect stable environments in their schools, Camburn says.

In disadvantaged schools, by contrast, one is most likely to find a principal focused on student affairs or instructional leadership.

Camburn cautions that his study’s measures of principals’ individual attributes were limited in what they captured and did not distinguish among groups of principals. Camburn encourages further research examining the role of leader attributes using more complex measures of personality, such as persistence, openness, and social appraisal skills.
Making Students’ Algebraic Thinking More Visible

Making the transition from arithmetic to algebraic reasoning is difficult for many middle school students. But successful transition is very important because it can shape their ability to succeed with more advanced mathematics.

Teachers help students learn to think algebraically by showing them how to understand patterns, relations, and functions; how to use symbols to represent and analyze mathematical situations and structures; and how to use mathematical models (graphs, tables, and equations) to represent and understand quantitative relationships.

But teachers need to be able to recognize opportunities for algebraic thinking when they arise. UW-Madison education professor Sharon Derry and colleagues Margaret Wilsman and Alan Hackbarth found a way to help teachers improve their ability to see these opportunities and to help students make that shift.

The project began as a summer workshop and continued during the school year with monthly meetings and online interactions. Teachers entering the year-long course were not articulate in their algebraic reasoning about student work. They came into the course without knowing how to recognize student work as algebraic, communicate about it in algebraic terms, reflect on their initial evaluation of student work, or reflect on their change in understanding of algebraic thinking. Some middle school math teachers have difficulty seeing examples of algebraic reasoning in their classrooms and curricula because these often don’t look like the familiar formulaic versions of algebra.

The course used what’s called contrasting cases instruction. When student or adult learners are specifically asked to use one example, or case, to understand another, they learn to abstract—and later, to transfer and use—the underlying structure. The cases might, for example, be different artifacts of teachers’ work—ways of representing and solving problems in which algebraic thinking is not immediately obvious. However, learners do not spontaneously make such comparisons; they must be trained and coached to do so.

The summer course goals included developing teachers’ ability to:

- interpret and compare multiple representations and solutions of mathematical tasks in their students’ work;
- generalize solution strategies across multiple representations and solutions; and
- see and explain algebraic thinking in their students’ representations and in their own.
The course involved developing what mathematics educators call *representational fluency*—that is, the ability to make meaningful links among representational forms and to translate from one representation to another.

During the academic-year course, teachers were asked to shift their focus from their own mathematical practices to their students’ algebraic thinking. The everyday work of teaching became the object of their ongoing investigation and thoughtful inquiry. That’s because teachers must be able to recognize the opportunities in their curriculum to develop conceptual understanding of mathematics before they can help their students develop such understanding. In this course teachers learned to decide what representations of such understanding would look like in their students’ work.

As a result of the course, teachers significantly improved their pedagogical content knowledge related to the course goals. They did not, however, improve in their tendency to spontaneously “reflect in action” on the adequacy of their own judgments about students’ knowledge and solutions. While this was not a stated objective of the course, Derry did assume that requiring teachers to repeatedly reflect on their own problem solving would enhance their ability and tendency to do the same for their students. Derry concluded that the course did enable teachers to better reflect on problem solving when they were prompted to do so. Teachers completing the summer course learned to make stronger inferences about students’ mathematical thinking, ability, and trajectories. Even greater increases were observed for teachers who completed the year-long course.

The course aimed to create common language, mindsets, and knowledge that Derry could build on in future work with these teachers analyzing their classroom practice. Data suggest that they were successful: A video analysis of student work showed significant increases in the mathematical sophistication of teachers’ descriptions of problem solutions.

A goal for Derry’s future work is to better understand reflection and its role in learning, as a prelude to designing instructional activities for enhancing reflective practice.

The course Web site can be examined for more details on continuing monthly meetings. http://stellar.wceruw.org

Funding: This course was part of a research project sponsored by the National Science Foundation.
Hypertext System Anchors Science Curriculum

Scientific knowledge seems to grow at an exponential rate.
The sheer amount of data, knowledge, and understanding of the world and of the universe keeps growing. Approaches to science education also change over time.

Of course science education still involves teaching students about the current scientific knowledge base. But another part of science education receiving attention is teacher-facilitated inquiry—that is, helping students learn how to ask a scientific question, how to pursue that question through a series of activities, and how to make activities and data sources cohere.

When science teachers adopt innovative curricula, it’s important that they structure students’ activities as a unit, rather than as a set of linear, discrete events. That’s because students learn with deeper understanding when the teacher has woven the concepts and activities into a coherent whole. Recent research by UW-Madison education professor Sadhana Puntambekar has helped to pinpoint how that’s done, and how science teachers effectively facilitate classroom discussion.

Coherent presentation of activities in a science unit is especially critical when students use a variety of information resources—for example, books, CD-ROMs, and hypertext systems—along with their hands-on activities. Students need teacher help, or scaffolding, as they work to make sense of all the available information.

Puntambekar studies the ways middle school science teachers enact the curriculum. In a recent study, she compared two teachers’ approaches to enacting an inquiry curriculum. Both teachers taught a unit on simple machines using an approach to science education called CoMPASS. CoMPASS consists of a computer hypertext system and accompanying science curriculum modules based on the pedagogical principles of learning by design. Learning by design emphasizes the value of learning through creating, programming, or participating in other forms of design. The approach values both the process of learning and its outcomes or products.

The CoMPASS hypertext system (see illustration) helps students learn by making more visible the relations between science concepts and principles. It presents students with two representations of science content—text and concept maps. Students navigate through the system in multiple passes during problem solving as they proceed through their hands-on activities in a science unit.

Puntambekar observed and videotaped the two science teachers and their 146 sixth-grade students, who represented different ethnic backgrounds, socioeconomic levels, and academic abilities. One teacher, Jane (a pseudonym), incorporated an inquiry approach in her teaching. While structuring the unit carefully, she allowed students a certain amount of freedom to explore. The second teacher, Linda (a pseudonym), followed a more highly structured approach. She often told students how to complete activities. Although Linda had been teaching longer than Jane, she was new to implementing an inquiry curriculum.

This unit on simple machines required students to work with a set of pulleys to lift a weight using the least amount of effort. Students brainstormed their initial design ideas and drew plans. They were challenged to design the best system using fixed pulleys, movable pulleys, or both. Using scales, students measured effort and distance. They raised questions and used CoMPASS to find information to help them with their challenge. A prize awaited the winning group.

Students in both classes carried out all the activities in the three phases of the unit: early brainstorming and question generation; small-group facilitation while students used CoMPASS; and whole-class discussion after students completed their challenge. However, the way the teachers sequenced the activities within the 2-week period was very different.
Students refer to CoMPASS to refine their initial design ideas and to find out more about a specific topic; then they optimize their designs and interpret the data they collected.

On the whole, Linda taught the unit in a linear fashion. Each activity was completed as a “task,” and there was little overlap between any two activities. In contrast, Jane carried out the different phases of the pulley challenge as an interconnected set of events.

By contrast, Jane’s discussion helped students “situate” the current activity. First, she enabled them to solve the pulley challenge in the context of the simple machines unit as a whole, as well as everyday knowledge of pulleys. Second, she used “relating activities” to help students understand the purpose of their inquiry, and she restated students’ comments and questions. Third, she helped students raise questions that were deep, as opposed to “fact” questions, and she provided students with encouragement.

Linda gave students many instructions. Throughout the three phases of the unit Linda emphasized task completion and providing instruction over reiterating big ideas, helping students make connections between concepts, or helping them relate abstract science concepts to their hands-on experiences.

Jane’s facilitation, however, helped students understand that the questions they raised had a purpose. In other words, she kept their focus on their goal. She also encouraged them to see the relation between asking questions and finding information. In short, she helped them to relate different activities to one another.

To summarize, in Jane’s class, the brainstorming session focused on grounding the current investigation in what students already knew, both from school and from their real-world experience. Jane helped them connect the activity of generating questions to the research in CoMPASS and to the overall goal of designing the best pulley system. After students raised questions in class, Jane asked them to select the questions that would best help them complete the challenge. She also asked them to focus more on understanding the purpose of finding information on CoMPASS than on answering all the questions.

Linda’s discussion with the students revolved around the questions that she had given them—for example, Why is power important? Students were mostly writing down information verbatim. Linda’s students were finding answers to her questions, not ones that they had generated and understood. Linda also provided answers during small-group interactions, whereas Jane focused on having students find the information and asked them more questions.

This study found no differences between students’ scores on the multiple-choice questions in the posttest. However, students in Jane’s classes performed significantly better than those in Linda’s classes on the open-ended questions and in the concept-mapping test. Both measures tapped students’ deeper understanding of science phenomena.

Linda’s struggles with inquiry teaching are not unique to teachers implementing a project or design-based curriculum for the first time and are well-documented through research in the learning sciences. Based on the lessons learned in this study, the CoMPASS team has designed a comprehensive program of professional development. The program has been successful in helping teachers who are new to the inquiry approach learn a different way of facilitating learning in classrooms.

More about the CoMPASS project: http://www.compassproject.net/info/index.htm

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