U.S. SCIENCE EDUCATION

Data Say Retention Is Better Answer To 'Shortage' Than Recruitment

Most efforts to improve STEM education start with recruitment. But working with those teachers already in the classroom may yield a bigger payoff

Finding science teachers who want to teach at Henninger High School has never been a problem, says Mickey Grosnick. Grosnick should know: She graduated from the Syracuse, New York, public school in 1967, returned there 16 years later to teach biology, and spent almost 2 decades as chair of the science department before retiring in June after a 37-year career as a secondary school science teacher in the district.

But keeping them is another story. Grosnick remembers a year earlier in the decade when a wave of retirements at Henninger required the hiring of five new science teachers at the same time. (The school typically has a fairly low turnover rate.) Within a few years, however, all of them were gone. "There were a lot of reasons. They didn't like the setting, the large classes, the confrontations with students, the lack of resources," says Grosnick. "I guess they just weren't comfortable teaching in a large, urban district.

Conventional wisdom has it that the dismal performance of U.S. students on international math and science tests can be blamed in large part on an inadequate supply of good teachers. That assumption has fueled initiatives by several higher education and business groups aimed at eliminating the shortage by pumping up the supply. And the White House has applauded the effort. In his 2006 State of the Union address, President George W. Bush announced that his Administration would strive to "bring 30,000 math and science professionals to teach in classrooms. President Barack Obama has talked repeatedly of "preparing 100,000 STEM [science, technology, engineering, and mathematics] teachers over the next decade. And last week, at a White House science fair, Obama reiterated his belief that training more STEM teachers is the key to meeting his goal "to move [the country] from the middle to the top in math and science education over the next decade.

But what if the conventional wisdom is wrong? Is there really a national shortage of STEM teachers?

A new analysis by Richard Ingersoll, an education policy researcher at the University of Pennsylvania who has tracked teacher workforce issues for 2 decades, suggests that the problem lies further down the pipeline. The title of his article in the September issue of the *American Educational Research Journal* poses the provocative question, "Is the Supply of Mathematics and Science Teachers Sufficient?" And his answer, unambiguously, is yes. "The problem is retention, not recruitment," says Ingersoll. "In the same year that Bush called for recruiting 30,000 STEM teachers, we had 26,000 quit. That's a terrible waste of talent.

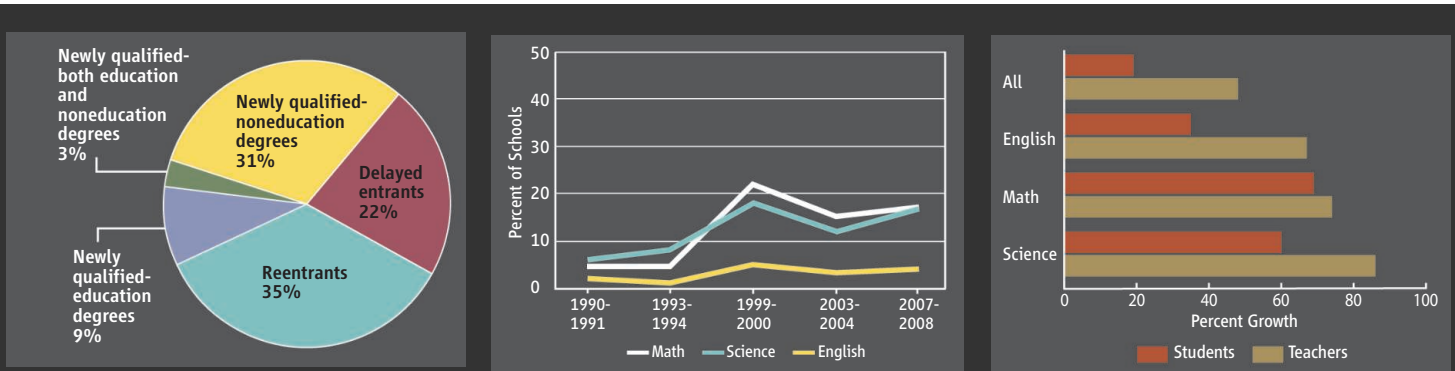
That conclusion, he admits, "is heresy" to most science educators and advocates. It also has important policy implications (see sidebar, p. 581). "When I started this work I assumed, like everybody else, that we have a critical shortage," he says. "And it was only slowly that I came to these contrarian views. Now I'm getting hate mail from people saying that I'm undermining their arguments to politicians and college presidents about the need to train more STEM teachers.

There are approximately 3.6 million public school teachers working in 90,000 school districts across the 50 states. Almost 500,000 are classified as math and science teachers. (That number represents only secondary schools—grades 7 through 12. Elementary school teachers are generally certified to teach all subjects, and there are no reliable figures for how many concentrate on science or math.) And every year, the media report that some school districts are struggling to find enough math and science teachers.

Ingersoll wanted to get a better handle on the supply side and to replace anecdotes with hard data. So he examined teacher flows, that is, the number of teachers hired for any particular school year and the number who leave, for whatever reason, at the end of the year. Ingersoll combined data from three federal education surveys to paint a much more complete, and nuanced, picture than ever before of those joining and leaving the STEM teacher workforce.

One discovery was that newly certified teachers fresh out of education schools—the usual metric for whether the country is producing "enough" STEM teachers—were only a small part of the overall hiring pool. The single biggest source of new staff members is what he calls reentrants: teachers with math and science degrees who are not currently in the classroom (see pie chart). The next biggest group is those with STEM content degrees (biology or chemistry rather than education, for example), followed by those who delayed their entry into the pro-

GRAPH: ADAPTED FROM R. INGERSOLL *ET AL.*, *AMERICAN EDUCATION RESEARCH JOURNAL*, **47**, 3 (SEPTEMBER 2010)



Data, at last. This pie chart (*left*) shows the backgrounds of math and science teachers hired in 1999, which was a peak year for schools having trouble filling vacancies (*middle*). The bar graph (*right*) shows that the teacher supply has grown faster than enrollments over the past 20 years.

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fession after becoming qualified to teach in a STEM field. Only one in eight is a newly minted teacher with either an undergraduate degree in education or both content and education degrees.

Ingersoll's analysis also shows that, despite burgeoning student populations and more required math and science courses, the supply of math and science teachers actually increased at a faster rate between 1988 and 2008 than did enrollments in those courses. (Of course, schools don't have the option of leaving a classroom vacant, as a company might leave a position unfilled until it finds the right person.) The widespread perception that math and science are "shortage" areas, he surmises, comes from the attention given to a relatively small percentage of schools that must scramble to fill their teaching rosters. Turnover among STEM teachers isn't any higher than for other fields, he finds, but there's less of a cushion of candidates in math and science than in, say, English or social studies.

In a second paper, from the Consortium for Policy Research in Education (CPRE), Ingersoll and consortium colleague Henry May examine the factors leading to staff turnover. For math teachers, the lack of classroom autonomy, weak professional development, and student discipline are the primary reasons for leaving. Professional development and discipline are also important for science teachers, although low salaries are their biggest gripe. (Math teachers don't cite salary as a major concern.)

The CPRE paper reports that "high poverty, high minority, and urban public schools have among the highest mathematics and science [teacher] turnover levels. But it's lousy working conditions, not bad students, that contribute to high mobility, says Ingersoll: "Teachers aren't fleeing poor kids. They are fleeing poor jobs. The solution is to address the reasons teachers are leaving rather than continually trying to refill a leaky pipeline, says Ingersoll, adding that the solutions to many of the problems wouldn't involve a lot of money.

Not surprisingly, some researchers have raised questions about some of Ingersoll's assumptions. Jennifer Presley, head of science and mathematics education policy at the Association of Public and Land-Grant Universities (APLU), thinks Ingersoll has exaggerated the reserve pool of teachers. She argues that many more teachers than he assumes drop out for good once they leave a job, and others with degrees never enter the classroom. She also points out that data Ingersoll relies on are nearly 10 years old and may not reflect current conditions. Others accept his overall conclusion but maintain that a shortage does exist in some areas, especially physics.

Much of the data in both papers are drawn from 1999–2000 because all three federal surveys, done periodically, were conducted during that academic year. (The Schools and Staffing Survey is based on a random national sample of teachers, principals, and school districts. The Teacher Follow-Up Survey tracks a representative sample of those teachers 1 year later. And the Baccalaureate and Beyond Longitudinal Survey polls a representative sample of new bachelor's-degree recipients.) That year was also a peak for schools reporting serious difficulties in filling teacher vacancies, Ingersoll notes, meaning that the data should capture any purported shortage at its worst.

Presley, who's working with 125 of APLU's member institutions on an initiative to train more science and math teachers, acknowledges that "I have a bit of a conflict because we're trying to encourage our institutions to provide the type of teacher preparation that the country so desperately needs. And I feel that those efforts will definitely raise the quality of the teacher workforce.

But she's not letting that conflict cloud her professional judgment. "I think that it's quite a thoughtful paper," Presley says about Ingersoll's work, "and I actually agree with most of it.

–JEFFREY MERVIS

What's in a Number?

Ingersoll's research does more than just question whether teacher recruitment should be the top priority for improving science, technology, engineering, and math (STEM) education in the United States. It also casts doubt on the key number President Barack Obama uses to promote his education policy. The source is *Rising Above the Gathering Storm* (*RAGS*), a 2005 National Academies' report that recommends offering 4-year, government-funded STEM scholarships to "annually recruit 10,000 of America's brightest students into the teaching profession." Obama's self-proclaimed "ambitious goal" of preparing 100,000 new STEM teachers, for example, would continue that level of output for a decade.

To be fair, the academies' report also talked about the need to improve the quality of the STEM teaching force. But policymakers overwhelmingly mention its emphasis on boosting the number of teachers when they cite the report.

But how does that number compare to current levels of production? And how far would training 10,000 more STEM teachers a year go toward achieving Obama's goal of making the country No. 1 in math and science education?

At the wheel. President Obama tests a device to combat distracted driving at the White House science fair.

Michael Allen, an educational consultant who's working with the Association of Public and Land-Grant Universities (APLU) on an initiative at 125 member institutions to train more science and math teachers, conducted a futile search for what would be the first logical step toward specifying the number of new teachers needed. "I find it totally incredible that no agency collects data on how many math and science teachers are credentialed each year," he says. "I think that the number in the *RAGS* report was taken out of thin air."

Ellen Lagemann, an education historian at Bard College in Annandale-on-Hudson, New York, and former dean of the Harvard Graduate School of Education who co-chaired a recent study by the National Academies on teacher preparation programs, believes that "the number is essentially meaningless." Her report, which focused on reading, math, and science, found that "there have been no systematic efforts to collect the necessary data" to know who's being trained for what, much less the quality of the instruction. Even its seemingly innocuous description of the type of research needed to determine what needs to be improved provoked a dissent from one panelist who complained that the literature is too sparse to even design such studies.

"Until we get better baseline data on how many teachers are being trained and the nature of that preparation," says Lagemann, "it's just plain silly" to try to quantify what's needed. **–J.M.**

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