Learning in the Teaching Workforce

Heather C. Hill

Summary

The U.S. educational system invests heavily, in both time and money, in continuing education for teachers. In this article Heather Hill examines the effectiveness of two forms of teacher learning—graduate coursework and professional development.

She focuses first on graduate education. Almost half of all teachers have a master's degree. Many states allow graduate coursework to count toward recertification requirements. Some districts require teachers to complete a master's degree within several years of hiring, and many others reward it with salary increases. Education reformers often recommend requiring master's degrees. But much graduate coursework appears to be of low intellectual quality and disconnected from classroom practice. Most research finds no link between teachers' graduate degrees and student learning unless the degree is in the teacher's primary teaching field.

Hill then examines professional development. Most workshops, institutes, and study groups appear to be brief, superficial, and of marginal use in improving teaching. But it does not have to be this way, says Hill. Professional development can enhance teaching and learning if it has three characteristics. It must last several days or longer; it must focus on subject-matter-specific instruction; and it must be aligned with the instructional goals and curriculum materials in teachers' schools. Such high-quality programs do exist. But they are a tiny fraction of the nation's offerings. One problem, says Hill, is that researchers rarely evaluate carefully either local professional development or its effect on student learning. Most evaluations simply ask participants to self-report. Lacking reliable evaluations, how are teachers and district officials to choose effective programs? Clearly, much more rigorous studies are needed.

To make continuing education effective, school districts should encourage teachers to take graduate coursework that is more tightly aligned with their primary teaching assignment. And districts should select professional development programs based on evidence of their effectiveness. Finally, central planners must ensure that items on the menu of offerings closely align with district standards, curriculum materials, and assessments.

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When teachers enter the workforce, their education is far from complete. The first years of teaching are themselves powerful instructors, as teachers gain familiarity with the students, materials, and content that they teach. Studies that link student achievement to teacher characteristics frequently identify an advantage, in terms of student gains, for teachers who are beyond the first several years of teaching. In addition, most states predicate the renewal of teaching certificates on continuing education in the form of additional university coursework and degrees, professional development, or both.[1] In national surveys, nearly every teacher reports participating yearly in one of these activities. Teachers' continuing education, then, might prove a key resource for improving workforce knowledge and skills. But is it?

In this article I review research on teachers' continuing education. I use the term *continuing education* to encompass two distinct categories of learning opportunities: those that yield graduate-level credit and degrees and those traditionally called "professional development," but now viewed by many scholars as inclusive of not only workshops and in-service programs but also school-based teacher study groups, mentoring relationships, and even experiences such as becoming certified by the National Board for Professional Teaching Standards (NBPTS). To assess teachers' continuing education and its effects, I address four sets of questions. First, what requirements and incentives exist for participation, and how do teachers respond? Second, what do teachers *do* in continuing education? What content is offered for teachers to learn? Third, do these learning opportunities improve teaching knowledge and skill, and ultimately enhance student achievement? And finally, how effective is the *system* of continuing education in improving the knowledge and skills of the teaching force and in improving student achievement?

Throughout, I pay attention to the various incentives in the system—incentives for teachers, for professional development providers, and for district and state officials—that shape the availability and effectiveness of professional learning. I begin by reviewing the small research base on teachers' graduate education, then explore the larger body of research on teachers' learning in other formats.

Graduate Education

Like many other professionals, teachers pursue graduate degrees either to enable entry into the field or to continue formal training once in the workforce.

Incentives and Requirements for Graduate Education

According to government statistics, approximately 45 percent of teachers have a master's degree.[2] Two types of master's degree are typical. One is a Master of Arts in Teaching, usually earned in a one-year program by those seeking a career change through certification. The second is a more general degree, pursued by teachers already in the labor force. Although no firm data exist on the prevalence of either degree, government statistics show that the share of teachers holding master's degrees jumps from 16 percent among those with three or fewer years of experience to 62 percent among those with more than twenty years of experience.[3] A national survey found that roughly one-fifth of all mathematics and science teachers reported having taken a disciplinary or discipline-specific teaching methods course within the past three years.[4] Wide enrollment

in graduate programs appears common in the teacher labor force. Why?

One reason is that incentives for pursuing such a degree are strong. More than thirty states allow graduate coursework to count toward recertification requirements. Some districts require teachers to complete a master's degree within several years of hiring. Many other districts provide salary increases for teachers who get a master's or specialist's degree. According to one report, the average salary increase is 11 percent for a master's degree and 17 percent for an education specialist's degree.[5]

What Do Teachers Do in Graduate Education?

Although participation in graduate education is common and although education reformers often recommend that master's degrees be required, little is known about the content of graduate coursework.[6] Existing studies tend to focus on the need for program redesign rather than on close examination of current offerings, but descriptions of these offerings suggest that many are of low intellectual quality, are disconnected from classroom practice, and are often fragmented, because teachers take courses to fulfill state requirements absent a coherent plan for learning.[7] Peggy Blackwell and Mary Diez quote from one teacher educator who decries the "drive-by" degree: "It's pre-service warmed over. If you apply, you get in; and if you get in, you get out."[8] More recently, incentives have shifted toward teachers' completing online master's programs in education, as these courses require no commuting or classroom time, and in some cases much less work than courses in bricks-and-mortar programs. The prevalence of poor-quality learning experiences has historical precedent: Blackwell and Diez note that until the mid-1800s, master's degrees were "essentially . . . an unearned degree given for a fee."[9] Understanding more about the content, rigor, and effects of online and traditional master's degree programs is a key area for future study.

Can Graduate Education Improve Teaching and Learning?

A number of studies have addressed the link between teachers' graduate degrees and student learning. In most cases, they find that having a master's degree is unrelated to student achievement. The handful of studies that find significant links find both positive *and* negative effects.[10] Thus the overall effect of graduate education on teacher productivity is likely close to zero. Significantly, though, most studies fail to determine whether a teacher's advanced degree is related to the subject he or she teaches.[11] Several studies that specifically examine the effects of teacher characteristics on high school students' mathematics achievement find that having a master's degree in *mathematics* significantly predicts student gains.[12] This finding, however, has been replicated only with high school students and their teachers, and the significant effects may be an artifact of the statistical models used rather than an outcome of real teacher learning. More mathematically proficient teachers, in this scenario, would choose to complete a master's degree in mathematics, and these more proficient teachers might improve student achievement even absent their higher degree. More rigorous studies are needed, including studies at other grade levels and for other subject areas.

Does Graduate Education Improve Teaching and Learning?

Overall, little evidence suggests that the *system* of graduate education improves the knowledge and skills pertinent to producing student learning. Teachers, responding to

state or district incentives, pursue advanced degrees and coursework. Higher education institutions—and increasingly, online "institutions"—respond to this market by providing easy-to-obtain degrees of varying, probably poor, quality. Without policy intervention, there are few incentives for change in this system.

Professional Development

More studies have examined the content and effectiveness of teacher learning in professional development settings—traditional workshops, institutes, and teacher study groups. In this section I discuss incentives for participation, the content of professional development, its effectiveness, and the effectiveness of the system in improving teaching and learning.

Incentives and Requirements for Professional Development

Nearly every state and school district provides inducements for teachers to participate in professional development. To start, most states give teachers the option of accumulating professional development hours or credits toward recertification; the modal state requirement is 120 hours over a five-year period.[13] A handful of states also require teachers to study specific topics or work with specific providers, and several require teachers to develop and follow professional development plans. School districts often add other requirements, including mandatory programs for all instructional staff or an investment of time beyond state requirements, or both.

The ubiquity of professional development is reflected in what teachers say they do. Data compiled by the National Center for Education Statistics (NCES) show that in 1999–2000, 99 percent of teachers surveyed reported participating in professional development activities over the past year.[14] But the time invested was typically brief: just over half of respondents reported the equivalent of one day or less of professional development, and only a minority reported more than thirty hours of study within the past year.[15] Although short workshops might be effective in providing piecemeal instructional activities or very general ideas, many scholars believe that given the complexity of teachers' work, short workshops have little effect on teaching or learning. And indeed, recent research identifies program length as one key predictor of teacher learning in professional settings.[16] Longer programs simply give teachers more time to learn.

What Do Teachers Do in Professional Development?

By all accounts, professional development in the United States consists of a hodgepodge of providers, formats, philosophies, and content. Most providers are locally based, serving school districts within the immediate geographic range.[17] Providers include local teachers and district personnel, independent contractors, university faculty, and curriculum materials publishers and their representatives. The learning opportunities they offer range from "one-shot" day-long workshops to extended institutes (typically a week or more in the summer) to forms of professional development embedded in teachers' daily work, such as lesson study (see box 1), mentoring and coaching, grade-level team meetings, or even more informal in-school collaborations.[18] There is also a range of philosophies about teacher learning, from those that advocate the direct instruction of teachers in specific teaching techniques to those that see teacher development as organic, driven by teachers' own needs, ideas, and self-directed learning. Content varies widely, from

Box 1. Lesson Study

One form of professional development now popular in the United States is lesson study. In lesson study, teachers collaboratively create a detailed plan for one lesson; one member of the group then teaches this lesson, while others observe. After the lesson, the group debriefs and revises the lesson—at which point it may be taught again by another teacher. In this excerpt below, a lesson study facilitator discusses his experience working with the mathematics faculties of two high schools.

For us, the biggest hurdle was convincing teachers to allow others to watch them teach. Whenever you approach a faculty with lesson study, once you say "other people will be watching you teach," half the people leave the room. We had to convince the teachers that the observers were not there to watch the teacher, but instead to watch the students. The observers' goal is to see whether the lesson the group has produced is going to be effective in producing student learning.

This means that the group has to create a lesson so that observers have something to observe. The lesson must be more participatory and involve students' voices more than typical lessons do. Otherwise the observers can't do their job. This in itself was a major shift for both of the faculties I worked with.

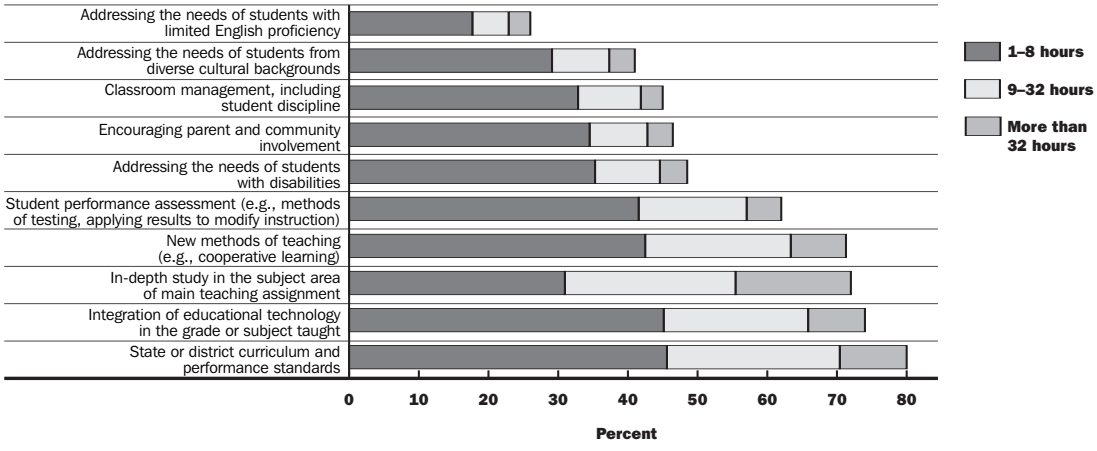
In one school, teachers' eyes were really opened to the idea that if you want to understand what students are learning from a lesson, you have to get students talking more. These teachers had never thought to do that. But beyond that, I'm not sure how much impact lesson study had; many teachers were doing it simply because the district thought it was a good idea. This faculty also had a history of little collegiality and lots of conflict. So perhaps just getting teachers to work together and watch one another teach will lead to good things.

In the other school, teachers' eyes were opened to this idea about student talk and learning. And teachers became a much more cohesive group. Previously, I'd say they were collegial, in the sense that they discussed what they were teaching that day, but they had never discussed *how* to teach it. Through lesson study, they realized that the *how* is really important to talk about.

"generic" workshops that outline general principles, such as active learning or cooperative grouping for any subject area, to highly specific topics, such as the use of particular software or how to deliver early reading instruction from a particular set of curriculum materials. As one might predict, neither form nor content of most professional development is standardized nationally; both are likely to be influenced heavily by the knowledge and predisposition of the provider, and perhaps secondarily by the needs of the district and teachers served.

In recent years, scholars and policymakers have led a reform effort driven by research that suggests that content-focused professional development is effective in changing what teachers know and do. The research recommends a focus on specific subject matter, curriculum materials, and teaching methods linked to subject matter and materials. It also recommends that professional development cover student learning of specific content and take place in novel formats, such as extended workshops, lesson study, or in-school mentoring and collabora-

Figure 1. Percentage of Teachers Choosing Selected Topics of Teacher Professional Development, 2000



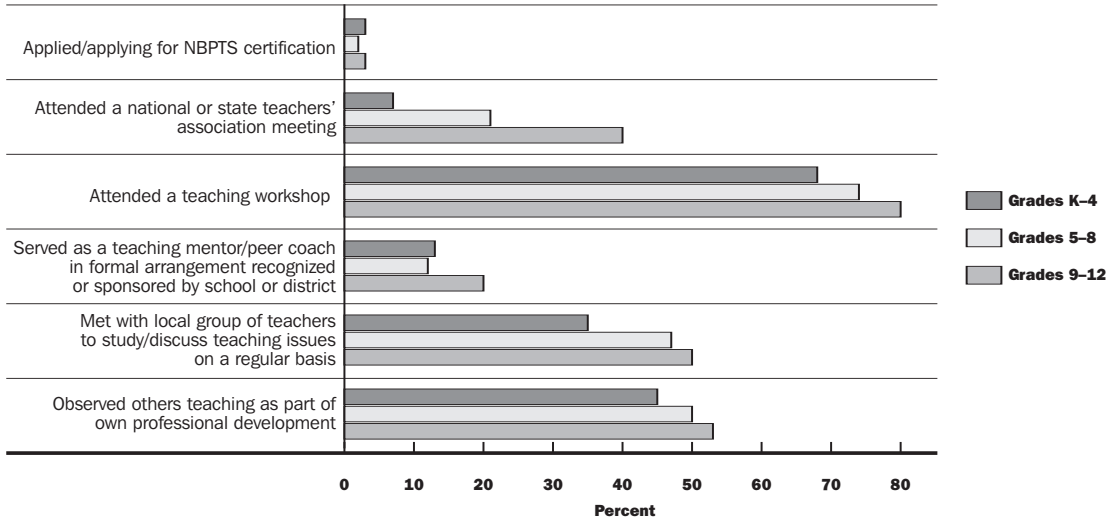
Source: National Center for Education Statistics, *Teacher Preparation and Professional Development: 2000,* NCES 2001-088 (U.S. Department of Education, 2001), table 2, p. 15.

tion. A key question is the extent to which professional development fulfills these recommendations.

Two sources of evidence bear on this question. The first is a national survey of K–12 teachers conducted by the National Center for Education Statistics in 2000. As figure 1 shows, "generic" professional development topics, such as student diversity, classroom management, and encouraging parental involvement, were relatively less popular than more subject-matter-specific topics, such as state or district instructional policy, in-depth study in content areas, and student performance assessments. Other NCES data from the same period show that 59 percent and 73 percent of teachers report focusing on subject matter content and methods, respectively, during their professional development experiences in the past year.[19] But figure 1 also reveals that most teachers report that such experiences last eight hours or less. The one exception is subject-matter-focused workshops, which most teachers report to last more than one day.

The second source of data is a survey of K–12 mathematics and science teachers in 2000, conducted by Horizon Research.[20] Teachers report both the format and the content of their professional development for these specific subjects. Figure 2 presents data on the format of professional development for teachers of mathematics. Traditional workshops, peer observations, and lesson study had the highest rates of teacher engagement in the three years before the study. Other activities, such as distance learning, serving as a mentor, attending state or national meetings, and applying for national board certification were less often reported. Data from other questions about the content of teachers' professional development show that popular topics in K–4 include deepening content knowledge, understanding student thinking, learning inquiry-oriented teaching methods, and assessing student learning; technology and special needs students were less frequent topics of study. Nevertheless, the share of teachers who reported that professional development focused on any of these topics "to a great extent" was quite small, ranging between 8 and

Figure 2. Percentage of Teachers Who Received Mathematics Professional Development in Selected Formats in the Past Three Years



Source: Horizon Research, *The 2000 National Survey of Science and Mathematics Education: Compendium of Tables* (Chapel Hill, N.C., 2002), p. 3.12.

NBPTS = National Board of Professional Teaching Standards.

11 percent for the most popular activities. By contrast, between 35 and 50 percent of teachers reported that last year's professional development did not focus at all or focused only slightly on any of these topics.

Results from these surveys suggest that although subject-matter-specific professional development is perhaps more prevalent today than in the past, efforts to reform teachers' in-service learning opportunities have been only partially successful. Further, the short duration of most teachers' professional development opportunities suggests that their experiences may be superficial or fragmented. The much-derided "generic" professional development workshop may be disappearing; what has replaced it is less clear.

Moreover, while national surveys can measure the *content* of professional development, they cannot assess its *quality.* Even professional development that meets standards for best practices, that lasts several days or longer, and that focuses squarely on subject-matter content, teaching, and learning can falter if content is presented inaccurately or if information about student learning is flawed or superficial.[21] Few studies, however, have examined the quality of professional development available to teachers who have not been fortunate enough to find respected providers or exemplary programs. Those studies that do are not encouraging. One reported that even an innovative and highly respected professional development program in mathematics had little intensive focus on mathematical ideas and content.[22] Another found that during the late 1990s most mathematics professional development treated elementary school mathematics superficially, offering fragmented explanations and disconnected activities to cover important topics.[23] In some cases, the math was barely evident amidst the "hands-on" activities done by teachers.

There is a clear need for more study in this area. Little is understood, for instance, about the overall preparation and knowledge of the people delivering professional development; about how content and quality vary from place to place; and about how well opportunities for professional development align with curriculum, assessments, and standards in the typical school district. These issues will become even more pressing as professional development services become available on a wider scale through the Internet and standardized curricula for teachers, a major trend that I discuss below.

Can Professional Development Improve Teaching and Learning?

Professional development can, unequivocally, enhance teaching and learning. Many carefully designed studies over the past twenty-five years have shown that teacher learning can lead to improved student outcomes. Several representative studies offer insights about what the research, as a whole, indicates about effective professional development.

Tom Good, Douglas Grouws, and Howard Ebmeier were among the first to study how teachers' professional development relates to student achievement.[24] As reported in 1983, the authors designed an intervention aimed at fostering "active mathematics teaching," including daily review, extended development of new mathematical content, and student practice with new content. They assigned teachers randomly to either a treatment or a control group. Teachers in the treatment group were given a detailed teaching manual and introduced to the program during two ninety-minute workshops. After two months, students of treatment teachers had gained a full standard deviation more than the students of control teachers on tests given before and after the intervention. This early experimental study suggests that professional development, in combination with a highly structured classroom intervention, can improve student achievement.

One of the best-designed and most widely cited studies focused on improving teachers' knowledge of children's problem-solving skills in addition and subtraction. As reported by Thomas Carpenter and colleagues in 1989, forty teachers were randomly assigned either to a month-long workshop on Cognitively Guided Instruction (CGI) or to four hours of more typical professional development.[25] In CGI, teachers studied research on children's thinking, discussed principles of instruction that might be derived from the research, and designed their own programs of instruction based on this research. The control group solved mathematics problems "of a more esoteric nature."[26] Students whose teachers attended CGI surpassed students in control classrooms in problem-solving skills; the two groups were roughly equivalent in solving simple addition and subtraction word problems. Classroom observations revealed that CGI teachers spent significantly more time on word problems than did control teachers and less time on number facts problems. CGI teachers also listened more frequently to students describing how they solved problems and were more supportive of students' use of different solution strategies.

More recently, in 2001, Geoffrey Saxe, Maryl Gearhardt, and Na'ilah Suad Nasir reported on a study examining how professional development focusing on fractions influenced teacher and student learning.[27] Teachers using new curriculum materials were randomly assigned to one of two groups. The first was an intensive program designed to build teachers' mathematical knowledge, to familiarize them with children's mathematical

thinking about fractions, and to introduce new instructional methods. The other was a support group for using the new materials; it did not study content or student learning but instead met periodically to discuss "particular practices: instructional methods appropriate for specific lessons; the role of manipulatives; assessment methods . . . ; and homework." Researchers who administered before and after tests on fractions to the students of these two groups of teachers found that students of teachers in the intensive group gained over a standard deviation more than students of teachers in the support group. Despite a small sample size, this effect was highly statistically significant (that is, the data are sufficient to ensure the result did not occur by chance).

Also in 2001 Deborah McCutchen and several colleagues analyzed a similar professional development program in early reading.[28] They assigned teachers either to a comparison group or to a two-week instructional institute focused on letter-sound relationships (phonology), student learning of letter-sound relationships (phonological awareness), and explicit instruction in both phonology and comprehension. Teachers in the treatment group deepened their knowledge of phonology as assessed on a pencil-and-paper test and engaged in more classroom activities directed toward phonological awareness (in kindergarten) and featuring explicit comprehension instruction (in first grade). Students whose teachers implemented the practices advocated by the professional development learned more than students of those who did not. Further, differences between the treatment and comparison groups emerged in first grade, with students taught by treatment group teachers performing significantly better on tests of phonological awareness, reading comprehension, vocabulary, and spelling.

A different kind of teacher development program is available through the National Board of Professional Teaching Standards (NBPTS). The NBPTS offers experienced teachers an opportunity to apply for and receive additional certification, which is viewed by many as an indicator of excellence in teaching and which in some districts and states leads to a salary increase commensurate with that of re-

Students whose teachers implemented the practices advocated by the professional development learned more than students of those who did not.

ceiving a master's degree. Notably, many national board–certified teachers report that the process of becoming certified, which includes developing and submitting a portfolio recording their teaching practice, is a substantial professional learning opportunity in itself (see box 2). Peer-reviewed journal articles on the effects of NBPTS certification on teacher learning and student achievement are scarce. A variety of reports and unpublished research have offered mixed findings, although the most carefully crafted study, by Dan Goldhaber and Emily Anthony, finds a small positive effect of NBPTS certification.[29] Yet it might be that any positive effect resulted not from teacher learning during the certification process, but because more effective teachers tend to apply for and succeed in the certificate program.

Although the content of effective professional development has varied over time and

Box 2. The National Board for Professional Teaching Standards

The National Board for Professional Teaching Standards (NBPTS) offers certification to educators. Candidates are evaluated on their performance on assessment center exercises—open-ended problems featuring common teaching dilemmas—and four portfolio entries. Teachers who gain NBPTS certification are rewarded with higher salaries in some districts and states. Below, an NBPTS-certified teacher discusses his experience.

I wanted at the end of my career to be able to say that I knew something about teaching elementary school, beyond just saying I'd taught for twenty years. The NBPTS had articulated some core ideas about teaching and learning that aligned well with what I care about. If I were going to be measured by something, that seemed like a pretty good set of standards.

When I completed the process, in 1997, there were six components to the portfolio. Each asks you to document some aspect of your teaching—for instance, how you use writing to advance content knowledge in another discipline, how you integrate science and social studies, and how you establish a classroom community. The methods of documentation included student work, lesson plans, and videotape of my actual teaching.

I worked with another teacher also going through NBPTS certification, which was a big help. Over the course of the year we worked, she and I would visit the other's classrooms, look through the other's materials, and read the other's narratives. My principal and another teacher also read sections of my application. Getting other people's feedback on my teaching, or having them look at my teaching and notice certain things, was pivotal for my learning.

The certification process also helped me learn that instruction is purposeful and targeted at student learning. The portfolio was tightly constructed around key questions: What are your purposes in teaching? How does your instruction help you achieve those purposes? And what did students learn?

The most powerful part of this experience was that it was embedded in work I was supposed to do anyway, like analyzing my students' work and planning instruction. It had a real impact on my day-to-day teaching with my kids. Professional learning grounded in my own practice through careful documentation of that practice, and interaction with others about that practice, was very rich and satisfying. So much so that my school developed a professional development group that used this same set of ideas. We worked together for another five years. We wanted to keep learning.

across disciplines, some general principles can be gleaned from these and other studies.[30] First, increasing the time invested pays off in terms of effects on teaching and learning. The studies discussed above typically engaged teachers in all-day summer institutes for between two and four weeks. Research does not indicate precisely how much time is sufficient, but one-day workshops, in most cases, are unhelpful. The exception is the Good, Grouws, and Ebmeier study, which paired a short workshop with a highly structured instructional intervention.

Second, content matters. Content that focuses on subject-matter-specific instruction and student learning—and in the case of mathematics and early word reading, helping

teachers learn the content itself—affects student achievement. In other words, teachers' learning opportunities should be grounded in the work they do in classrooms. When teachers study the content, curriculum materials, assessments, and instructional methods they will be using, student achievement improves. Using "classroom artifacts," such as student work or assessment results, is also a common feature of effective professional development. By contrast, several studies have suggested that professional development focused on more generic topics neither changes teaching nor improves student learning.

Third, teachers' professional development should be aligned with and support the instructional goals, school improvement efforts, and curriculum materials in teachers' schools. Learning about phonology, for instance, does little for teachers in schools where direct phonics instruction is not supported. And learning new ways to teach scientific inquiry does little for teachers who have no curriculum or lab materials to support such inquiry in class. Conversely, teachers will make better use of materials, assessments, and other classroom resources if their professional development is tied closely to those resources. At present, however, teachers are skeptical about the links between their professional development and school programs; only 18 percent report that their professional development is linked to a great extent to "other program improvement activities" at their school. Although another 38 percent report moderate links, 44 percent report few or no links between their professional development and school programs.[31]

Finally, there is a strong sense in the professional development scholarly community that collective participation of entire schools and "active" learning, such as reviewing student work, giving presentations, and planning lessons, lead to improved teaching and student outcomes. No rigorous studies, however, have investigated the effects of these aspects of professional development.

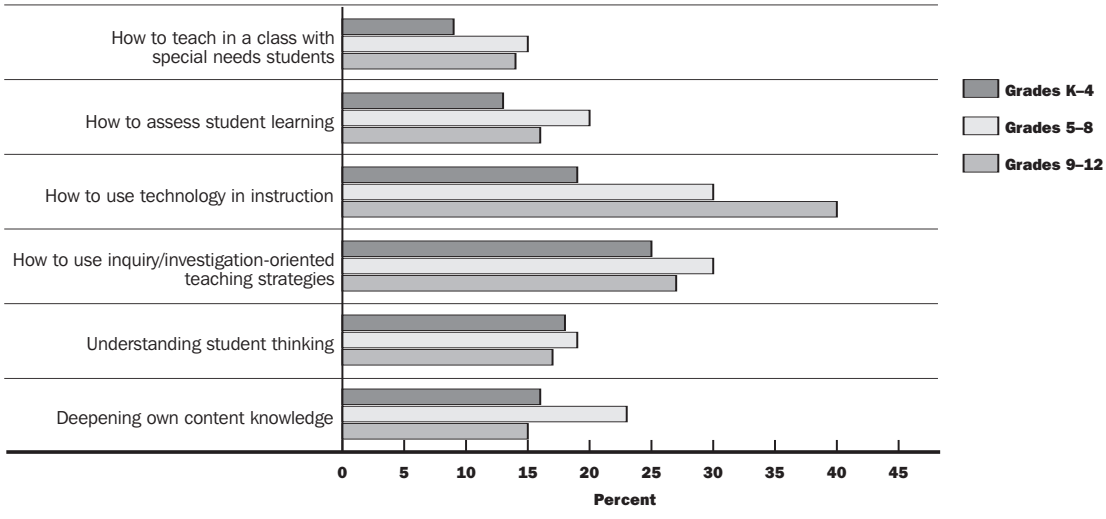
Does the Professional Development System Improve Teaching and Learning?

Despite positive news about the effects of specific professional development experiences, there is little evidence that the *system* of professional development, taken as a whole, improves teaching and learning in the United States. In fact, professional development is still widely believed, despite years of efforts at improvement, to be of marginal use. Even teachers are unenthusiastic about the quality of their own professional development; in Horizon's study, only one-fifth of science teachers and one-quarter of mathematics teachers reported that their professional development changed their teaching practices (figure 3). Very large shares reported that it only confirmed their existing practices. And self-reports are famously inflated.

One likely reason why professional development does not affect school outcomes is that only a tiny fraction of nationwide offerings are high-quality programs.[32] Although similar, locally grown programs likely exist, surveys by Michael Garet and others and by David Cohen and me suggest that quality programs reach relatively few teachers.[33]

Increasingly, however, nonprofits and commercial ventures have begun to publish or provide professional development materials that are intended for wide use. In mathematics, for instance, Developing Mathematical Ideas (DMI), a program from the Educational Development Center in Massachusetts, offers training and manuals for staff developers interested in using case-based professional

Figure 3. Percentage of Teachers Reporting That a Science Professional Development Topic "Caused Me to Change My Teaching Practices"



Source: Horizon Research, *The 2000 National Survey of Science and Mathematics Education: Compendium of Tables* (Chapel Hill, N.C., 2002), p. 2.16.

development. Cognitively Guided Instruction, discussed above, does much the same. Math Solutions, a two-decade-old firm in California, provides professional development widely through a combination of national and local staff (see box 3). Open Court, a curriculum materials publisher, offers summer institutes and video-based and online professional development in conjunction with its reading program. LessonLab offers teachers a combination of online and in-person study of mathematics and reading. Whether these efforts will improve teaching and learning on a large scale remains to be seen.

Another reason why there is little evidence that the system taken as a whole improves teaching and student learning is the sheer paucity of data about outcomes. Almost no local professional development—and even most efforts offered by respected university faculty, nonprofit, and commercial professional developers—is rigorously evaluated, in the sense of researchers looking for changes in teacher knowledge and instructional practice. Even more seldom do researchers investigate the effect on student learning. More often, evaluations simply ask participants to report whether and how the program affected their own teaching. One reason for the absence of rigorous evaluation is the complexity of mounting such a study: measuring teacher knowledge, skills, and practice is difficult; and measuring student achievement, even more so. Another reason, though speculative, is the lack of capacity in the local evaluation corps; anecdotal evidence suggests that most independent evaluators lack the research design or statistical skills necessary to conduct rigorous evaluations.

Lacking results from rigorous evaluations, teachers, district officials, and others are left without information as to which professional development opportunities enhance teacher performance and student learning. As any economist will quickly point out, consumer choice in an information-poor market does not generally lead to efficient outcomes; low-quality goods will persist, while high-quality

Box 3. Extended Professional Development in Mathematics

One increasingly common format for professional development is a summer institute followed by school-level collaboration and mentoring during the school year. One teacher reflects on her experiences with such a program, Math Solutions.

The two-week summer session was intense. There were long days, and then we had to go home and do mathematics homework. The math problems were very challenging and also very interesting. A friend of mine with a mathematics Ph.D. would often do the homework with me and comment on how interesting school mathematics could be.

Our whole school had a two-year contract to work with Math Solutions, which is very unusual in professional development. During the school year, Math Solutions program staff taught in my classroom. That by itself was an incredible help—even just watching them teach a single lesson with my students. Watching the questioning styles they used gave me a whole new toolkit. I had already been using novel math problems with my students, but this helped me to get those students to explain their answers more clearly, and to be less timid about rigorous mathematical work. I also came to understand how you can present algebraic ideas to second graders.

One benefit of the Math Solutions approach was that everyone in our school was in it together. It became a very collaborative effort—my grade-level team continued to work together on curriculum even after the formal professional development was over.

goods will go unnoticed. A district official, for instance, who wanted to compare the outcomes from professional development in mathematics offered by CGI, DMI, Math Solutions, and LessonLab could not do so, even though these are among the most widely used programs in the country. Even if all four programs had undergone rigorous before-and-after evaluations, there is no guarantee that the outcome measures would be similar, or even remotely comparable. Teachers and district officials thus lack the necessary resources to choose effective professional development.

A third reason for the lack of effects relates to the incentives in the system. Although teachers might be required to engage in professional development, they are not required to learn from it. For their part, providers' incentives are to sell more professional development—which means supplying programs that teachers enjoy, not programs from which they can learn.

A fourth reason for the lack of effect of professional development, as a whole, on teaching and learning is the incoherence of the system itself. One finding from research on professional development is that teachers learn more, or at least report learning more, when their opportunities to learn are aligned with the curriculum materials, assessments, and standards they are asked to use every day in their classrooms.[34] Although there is reason to believe that this coherence is growing—several publishers now offer substantive professional development that aligns with their curriculum materials, for instance—it is still relatively rare. More often, teachers might choose professional development from a list of available options, regardless of the materials and assessments used in their district.

Despite these shortcomings, professional development that is aligned with policy, instruction, and assessment is often cited as a key component of reform efforts at the school and district levels. For instance, throughout the 1990s New York City's District 2 maintained a comprehensive effort to improve instruction in specific content areas and used professional development as a chief instrument toward that end.[35] The district used a variety of professional development providers and a range of formats, from formal workshops to extended mentoring and peer networks. It even allowed control over the process at the school level. But the professional development system was anchored in a shared vision of instructional improvement, was pervasive, and was, in literacy, focused on a specific instructional approach.[36] More generally, because teacher professional development is often embedded in wider reform efforts, such as new policies, forms of assessment, and curriculum materials, it is difficult to separate out the effect of the professional development itself. Further, few high-quality studies of broadly implemented professional development exist. As the field moves toward more centralized provision of professional development services, there is a critical need for such study.

Conclusion

Fostering continuing teacher education is a significant undertaking, and constitutes a significant expenditure, in the U.S. educational system. Nearly every teacher participates in some form of continuing education every year. Graduate degrees bump salaries 11–17 percent for the nearly half of teachers who hold them. Cost estimates for professional development range between 1 and 6 percent of district expenditures, with many hovering in the 3 percent range.[37] The bulk of the cost lies in teacher release time and in planning time for those providers who work within school districts.[38] The vast majority of dollars and time, however, appears misspent.

Given this reality, the challenge is to design a system of continuing education that enhances teachers' ability to improve their own effectiveness and their students' achievement. The rudiments are in place, in that programs do exist that improve both. The challenge for policymakers is to motivate changes in the system of continuing education, and in particular to provide incentives for both higher-quality fare and more focused and deliberate teacher participation.

At the moment, there are many ideas, but there is little evidence, about how to proceed. Certainly, school districts should stop offering financial incentives for teachers to complete nonrelevant graduate degrees and start rewarding degrees that are more tightly aligned with teachers' primary teaching assignments. Districts should also select professional development programs and approaches based on evidence of their effectiveness. Programs lacking such evidence can be evaluated using teacher- and student-level outcome measures: change in teacher performance on pencil-and-paper assessments and classroom observation rubrics and change in basic measures of student achievement.[39] And central planners must ensure that items on the menu of offerings closely align with district standards, curriculum materials, and assessments. Whether choices about teacher learning are made at the teacher, school, or district level and regardless of who controls these choices, alignment must be tight. Finally, as more data from state, district, and formative assessments become available, continuing education can be crafted to fill gaps in teachers' knowledge and skills that can lead to poor student performance.

Notes

1. Lori Cavell and others, *Key State Education Policies on PK–12 Education: 2004* (Washington: Council of Chief State School Officers, 2004).

2. National Center for Education Statistics, *Teacher Preparation and Professional Development: 2000,* NCES 2001-088 (U.S. Department of Education, 2001).

3. National Center for Education Statistics, *Teacher Quality: A Report on the Preparation and Qualifications of Public School Teachers,* NCES 1999-080 (U.S. Department of Education/OERI, 1999).

4. Horizon Research, *The 2000 National Survey of Science and Mathematics Education: Compendium of Tables* (Chapel Hill, N.C., 2002).

5. Dan D. Goldhaber and Dominic J. Brewer, "When Should We Reward Degrees for Teachers?" *Phi Delta Kappan* 80 (1998): 134–38.

6. Karen Zumwalt and Elizabeth Craig, "Teachers Characteristics: Research on the Indicators of Quality," in *Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education*, edited by Marilyn Cochran-Smith and Kenneth Zeichner (Mahwah, N.J.: Lawrence Erlbaum Associates, 2005).

7. Peggy J. Blackwell and Mary Diez, "Toward a New Vision of Master's Education for Teachers" (Washington: National Council for Accreditation of Teacher Education, 1998); Alan R. Tom, "Reinventing Master's Degree Study for Experienced Teachers," *Journal of Teacher Education* 50, no. 4 (1999): 245–53.

8. Blackwell and Diez, "Toward a New Vision" (see note 7), p. 10.

9. Ibid., p. 6.

10. Rob Greenwald, Larry V. Hedges, and Richard Laine, "The Effect of School Resources on Student Achievement," *Review of Educational Research* 6 (1996): 361–96.

11. Andrew J. Wayne and Peter Youngs, "Teacher Characteristics and Student Achievement Gains: A Review," *Review of Educational Research* 73 (2003): 89–122.

12. Dan D. Goldhaber and Dominic J. Brewer, "Does Teacher Certification Matter? High School Certification Status and Student Achievement," *Educational Evaluation and Policy Analysis 22* (2000): 129–46; Brian Rowan, Richard Correnti, and Robert J. Miller, "What Large-Scale Survey Research Tells Us about Teacher Effects on Student Achievement: Insights from the *Prospects* Study of Elementary Schools," *Teachers College Record* 104 (2002): 1525–67.

13. National Association of State Directors of Teacher Education and Certification, *Knowledgebase Table E1: Professional Development Description* (Whitinsville, Mass., 2004).

14. NCES, *Teacher Quality* (see note 3), p. 11.

15. National Center for Education Statistics, *Characteristics of Public School Teachers' Professional Development Activities: 1999–2000,* NCES 2005-030 (U.S. Department of Education, Institute of Educational Sciences, 2005). This statistic came from the School and Staffing Survey, which asks the duration of teacher participation "in any professional development activities specific to and concentrating on the content of the subject(s) you teach." Given this wording, it is difficult to know what was included (for example, graduate coursework) or excluded (for example, school-based teacher study groups).

16. David K. Cohen and Heather C. Hill, *Learning Policy: When State Education Reform Works* (Yale University Press, 2001); Michael S. Garet and others, "What Makes Professional Development Effective? Results from a National Sample of Teachers," *American Educational Research Journal* 38, no. 4 (2001): 915–45; Heather C. Hill and Deborah L. Ball, "Learning Mathematics for Teaching: Results from California's Mathematics Professional Development Institutes," *Journal of Research in Mathematics Education* 35 (2004): 330–51.

17. Results from our attempt to locate and survey midwestern providers of professional development in mathematics afford one window into how the system works. Our goal was to locate the *average* professional development provider working in local school districts. Using three midwestern states as our sampling frame, we called all districts located in cities with populations of 20,000 or more and asked them to name the individual(s) providing mathematics professional development to teachers. Of roughly fifty professional development providers named by school district staff, only four resided outside the state in which they provided their service. Only four of twenty-six respondents to our actual survey reported that offering professional development was a full-time job; other respondents were curriculum coordinators, teachers, and consultants.

18. The comments in this and other boxes in this article come from interviews by the author with individuals who wish to be anonymous.

19. NCES, *Characteristics of Public School Teachers' Professional Development Activities* (see note 15).

20. Horizon Research, *The 2000 National Survey* (see note 4).

21. National Staff Development Council, *NSDC Standards for Staff Development,* www.nsdc.org/standards/index.cfm (August 2006).

22. Suzanne M. Wilson, Sarah Theule-Lubienksi, and Steven Mattson, "Where's the Mathematics? The Competing Commitments of Professional Development," paper presented at the annual meeting of the American Educational Research Association, New York, April 1996.

23. Heather C. Hill, "Professional Development Standards and Practices in Elementary School Mathematics," *Elementary School Journal* 104 (2004): 215–31.

24. Tom Good, Douglas Grouws, and Howard Ebmeier, *Active Mathematics Teaching* (New York: Longman, 1983).

25. Thomas P. Carpenter and others, "Using Knowledge of Children's Mathematics Thinking in Classroom Teaching: An Experimental Study," *American Educational Research Journal* 26 (1989): 499–531.

26. Ibid., p. 507.

27. Geoffrey Saxe, Maryl Gearhardt, and Na'ilah Suad Nasir, "Enhancing Students' Understanding of Mathematics: A Study of Three Contrasting Approaches to Professional Support," *Journal of Mathematics Teacher Education* 4 (2001): 55–79.

28. Deborah McCutchen and others, "Beginning Literacy: Links among Teacher Knowledge, Teacher Practice, and Student Learning," *Journal of Learning Disabilities* 35, no. 1 (2001): 69–86.

29. For studies that find a positive effect of NBPTS certification, see Dan Goldhaber and Emily Anthony, "Can Teacher Quality Be Effectively Assessed? National Board Certification as a Signal of Effective Teaching" (Washington: Urban Institute, April 2005). For studies that find small or no effect on student achievement,

see Charles Clotfelter, Helen F. Ladd, and Jacob Vigdor, "Teacher Quality and Minority Achievement Gaps" (Durham, N.C.: Terry Sanford Institute of Public Policy, October, 2004); and William J. Sanders, James J. Ashton, and Paul S. Wright, "Comparison of the Effects of NBPTS-Certified Teachers with Other Teachers on the Rate of Student Academic Progress" (SAS Institute, March 2005).

30. See also Garet and others, "What Makes Professional Development Effective?" (see note 16); Cohen and Hill, "Learning Policy" (see note 16); Paul Cobb and others, "Assessment of a Problem-Centered Second-Grade Mathematics Project," *Journal for Research in Mathematics Education* 22 (1991): 13–29.

31. NCES, *Teacher Preparation* (see note 2), p. 19.

32. For an elaboration of this argument, see Cohen and Hill, "Learning Policy" (see note 16).

33. Garet and others, "What Makes Professional Development Effective?" (see note 16); Cohen and Hill, *Learning Policy* (see note 16).

34. Garet and others, "What Makes Professional Development Effective?" (see note 16); Cohen and Hill, *Learning Policy* (see note 16).

35. Richard F. Elmore and Deanna Burney, "Investing in Teacher Learning; Staff Development and Instructional Improvement in Community School District #2, New York City" (New York: National Commission on Teaching and America's Future, 1997).

36. Mary Kay Stein and Laura D'Amico. "Inquiry at the Crossroads of Policy and Learning: A Study of a District-Wide Literacy Initiative," *Teachers College Record* 104 (2002): 1313–44.

37. Linda Hertert, *Investing in Teacher Professional Development: A Look at 16 Districts* (Denver, Colo.: Education Commission of the States, 1997); Kieran M. Killeen, David H. Monk, and Margaret L. Plecki, "School District Spending on Professional Development: Insights from Available Data (1992–1998)," *Journal of Education Finance* 28 (2002): 25–50; Judith W. Little, "District Policy Choices and Teachers' Professional Development Opportunities," *Educational Evaluation and Policy Analysis* 11, no. 2 (1989): 165–79; Allan Odden and others, "A Cost Framework for Professional Development," *Journal of Education Finance* 28 (2002): 51–74; Karen Hawley Miles, "Rethinking District Professional Development Spending to Support School Improvement: Lessons from Comparative Spending Analysis," in *School Finance and Teacher Quality: Exploring the Connections*, edited by Margaret L. Plecki and David H. Monk (Larchmont, N.Y.: Eye on Education, 2003).

38. Little, "District Policy Choices" (see note 37).

39. A number of instruments can be used to evaluate teacher learning from professional development. In reading, see McCutchen and others, "Beginning Literacy" (see note 28); Geoffrey Phelps and Stephen G. Schilling, "Developing Measures of Content Knowledge for Teaching Reading," *Elementary School Journal* 105 (2004): 31–48. In science, see "Assessing Teacher Learning about Science Teaching," www.horizon-research.com/atlast/; and also other instruments at www.horizon-research.com/instruments/. In mathematics, see "Learning Mathematics for Teaching," www.sitemaker.umich.edu/lmt; "Knowledge for Algebra Teaching," www.msu.edu/~kat/; and also Heather C. Hill and others, "Assessing Teachers' Mathematical Knowledge: What Knowledge Matters and What Evidence Counts?" in *Handbook for Research on Mathematics Education*, 2nd ed., edited by Frank Lester (Charlotte, N.C.: Information Age Publishing, forthcoming).