The Effect of Certification and Preparation on Teacher Quality

Donald Boyd, Daniel Goldhaber, Hamilton Lankford, and James Wyckoff

Summary

To improve the quality of the teacher workforce, some states have tightened teacher preparation and certification requirements while others have eased requirements and introduced "alternative" ways of being certified to attract more people to teaching. Donald Boyd, Daniel Goldhaber, Hamilton Lankford, and James Wyckoff evaluate these seemingly contradictory strategies by examining how preparation and certification requirements affect student achivement.

If strong requirements improve student outcomes and deter relatively few potential teachers, the authors say, then they may well be good policy. But if they have little effect on student achievement, if they seriously deter potential teachers, or if schools are able to identify applicants who will produce good student outcomes, then easing requirements becomes a more attractive policy.

In reviewing research on these issues, the authors find that evidence is often insufficient to draw conclusions. They do find that highly selective alternative route programs can produce effective teachers who perform about the same as teachers from traditional routes after two years on the job. And they find that teachers who score well on certification exams can improve student outcomes somewhat. Limited evidence suggests that certification requirements can diminish the pool of applicants, but there is no evidence on how they affect student outcomes. And the authors find that schools have a limited ability to identify attributes in prospective teachers that allow them to improve student achievement.

The authors conclude that the research evidence is simply too thin to have serious implications for policy. Given the enormous investment in teacher preparation and certification and given the possibility that these requirements may worsen student outcomes, the lack of convincing evidence is disturbing. The authors urge researchers and policymakers to work together to move to a more informed position where good resource decisions can be made.

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Donald Boyd is deputy director of the Center for Policy Research at the University at Albany, SUNY; Daniel Goldhaber is research associate professor at the University of Washington; Hamilton Lankford is professor of economics at the University at Albany, SUNY; and James Wyckoff is professor of public administration at the University at Albany, SUNY. The authors benefited from comments by Paul Decker, Pamela Grossman, Susanna Loeb, and participants at the Future of Children Conference on Excellence in the Classrooms. They appreciate very good research assistance from Kristy Michel, Noelle Ellerson, and Brian Pack. All errors are attributable to the authors.

In the United States individual states regulate the teaching profession through teacher certification programs that serve as gateways into the teaching profession. Every state has its own procedures for certifying teachers, and every public school is expected to hire teachers certified by the state. Certification always involves exams, often in both general knowledge and teaching skills, and it nearly always involves coursework and practice teaching. Ideally certification keeps poor teachers out of the classroom, while giving people with the potential to be good teachers the skills and experience they need to do their jobs well. But certification may also have an unintended consequence. Because the path to certification can be arduous, it may reduce the appeal of teaching for some people who could potentially become good teachers.

The renewed focus of U.S. education policy on the quality of classroom teachers and teaching is raising new questions about how the nation prepares and certifies its teachers. The commitment of the 2001 No Child Left Behind Act (NCLB) to school accountability and to improving educational outcomes for all students, together with improved monitoring of student achievement, has heightened public awareness of long-standing sociodemographic gaps in student achievement. Dramatic disparities in the qualifications of teachers across schools and newly documented disparities in teachers' ability to influence student achievement mean that poor, minority, and low-performing students are much more likely to have teachers who are inexperienced, uncertified, and less academically able than their higher-performing peers. The achievement of these students suffers as a result.

But improving the quality of the teacher workforce is a challenge. Increased school enrollment, high rates of teacher attrition (particularly in the most difficult-to-staff schools), and the retirement of baby-boom teachers complicates efforts to hire high-quality teachers. Policymakers have addressed these issues of teacher quality and quantity in a variety of ways. Some states have tightened regulation of teacher preparation and certification—for example, extending course requirements for teachers and imposing more entry exams. Many states have also tried to attract more and different people to teaching by reducing entry requirements and introducing "alternative certification" programs. Although the two approaches are seemingly at odds, each could potentially either improve or reduce the quality of the pool of potential teachers. The precise effect of each depends on how it interacts with complicated labor market dynamics driven by teachers' preferences, local school systems' hiring decisions, and economic fluctuations.

We begin our analysis by describing the traditional and alternative routes that teachers follow to enter the profession. We then survey research that examines the relationship between teacher preparation and student achievement, between certification exams and student achievement, between certification requirements and the supply and qualifications of people pursuing teaching careers, and between the hiring decisions of school administrators and the qualifications of teachers. We conclude by offering some recommendations for policy.

Routes into Teaching

Traditionally most U.S. school districts have hired graduates of teacher preparation programs operated by schools of education in the nation's colleges and universities. Successful completion of such programs is by far the most common route to teacher certifica-

tion. But many difficult-to-staff urban and rural schools, unable to hire enough teachers from traditional preparation programs, especially in subject areas such as math, science, and special education, are forced to hire uncertified teachers, who thus become concentrated in schools with the lowest-performing students. For example, Lankford and several colleagues find that in New York State, teachers in elementary schools with 20 percent or more of fourth graders in the lowest performance group on English language arts exams were five times more likely to be uncertified to teach any of their current assignments than teachers in schools with fewer than 5 percent of fourth graders in the lowest performance group.[1] Other research finds similar sorting in other schools.[2]

No Child Left Behind aims to change this landscape by requiring states to ensure that all teachers are "highly qualified." The legislation considers new teachers highly qualified if they receive state certification and demonstrate content knowledge of the material they teach, either by passing a subject-area exam or by having an undergraduate major in that subject, or both. Veteran teachers can meet NCLB's "highly qualified" teacher standard either by passing subject-area exams or through a process known as the High Objective Uniform State Standard of Evaluation (HOUSSE), defined separately within each state.[3] The "highly qualified" requirements are not particularly stringent, but many states and districts have nevertheless had to struggle to meet them.

States have thus implemented incentive programs to attract people into teaching, particularly in difficult-to-staff subject areas and difficult-to-staff schools. They have also introduced new routes into teaching that have fewer up-front requirements. These alternate routes and programs have become an important source of supply for many schools, especially those that are difficult to staff.

Comparing the preparation and qualifications of teachers entering the profession through these two routes is not easy. Little systematic information is available about either the structure or the content of their

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preparation or about how effective these teachers are in the classroom. Nor are there systematic national, or even state, databases on the content of teacher preparation programs generally. No national database collects information on the coursework or other aspects of the preparation of individual teachers, though some studies of particular school districts or states are beginning to develop such data.[4] There does not even appear to be a repository for information about the various requirements of schools of education. It is possible, however, to get data on state certification requirements, and these varying requirements give at least some sense of the range of preparation that teachers receive. Many programs may exceed the minimum requirements for certification and many individuals within these programs likely exceed the minimum program requirements. Moreover, there is considerable variation in the content of purportedly similar courses and experiences.

States set their certification requirements independently, subject only to the NCLB requirements for highly qualified teachers. In practice, many states have similar certification requirements. All states require teachers either to complete an approved preparation program or to pass one or more certification exams. The vast majority of states require both. States do vary somewhat in the knowledge and skills they consider important for teachers, what kind of education they require, and the timing of that education relative to when people begin teaching. As observers are increasingly aware, there is more variation within certification programs than across them.[5] Thus traditional preparation in some states may look very similar to alternative preparation in others.

In the remainder of this section we summarize the certification requirements of both the traditional teacher preparation route and the alternate route to give some sense of how the minimum threshold for teacher preparation varies among the states. We discuss other credentials that some teachers pursue and then examine the certification exam requirements for teachers.

Traditional Preparation

Traditional teacher preparation programs are the primary source of teacher supply in most states. These programs are shaped by a combination of state regulations, the criteria of accreditation groups, and the choices made by individual programs and institutions. States approve teacher education programs, enabling them to offer degrees. Would-be teachers who successfully complete approved programs need only pass any required certification exams to become licensed. States assume that by completing the state-approved preparation program, teachers have met the preparation component of certification, including required course content and field experiences. Required course content falls into three broad areas: foundational courses (for example, learning and development, philosophy or history of education, multicultural education); pedagogical courses (for example, methods of teaching or classroom management); and content or subject-matter knowledge. Programs also require candidates to complete field experiences, where they link their education to teaching experiences. Many preparation programs supplement these three areas with additional coursework, or present existing courses within a framework that addresses a specific orientation or mission, such as urban education, though information about such aspects of the programs is largely anecdotal.

Table 1 describes several key state requirements for teacher preparation as of 2006.[6] One important requirement addresses the content knowledge of subject-area teachers. Twenty-five states require high school teachers both to have a major in their subject area and to pass a content-knowledge exam. Six states require teachers only to have a major in their subject area, while eighteen other states require them only to pass a content-knowledge exam in their area.[7] Within these requirements, however, the content knowledge that constitutes a major or that must be demonstrated on certification exams varies widely.

Most traditional teacher preparation programs devote significant resources to teaching pedagogy, the skills that enable teachers to structure and communicate material to students; and most states also require teachers to demonstrate knowledge of pedagogy through exams or coursework. Pedagogy includes knowledge of instructional methods, learning theories, measurement and testing,

Table 1. Illustrative Attributes of Teacher Preparation Programs Required for State Certification

State	Content knowledge			Pedagogy			Field experience
	Subject-area requirements for beginning teachers		Percent of secondary teachers who majored in their core academic subjects in 2000	Nature of students' learning process	Subject-area pedagogy	Classroom management	Minimum student teaching (weeks)
	High school	Middle school					
Alabama	Major	Major	65	E, M, S	E, M, S	E, M, S	15[a]
Alaska			53	No	No	No	
Arizona			52	No	No	No	
Arkansas			64	E, M, S	No	E, M, S	12
California	Major[b]		59	E, S	E, S	E, S	9
Colorado	Major[c]		62	. . .	. . .	. . .	13[d]
Connecticut	Major	Minor	64	. . .	. . .	E, M, S	10
Delaware			55	No	No	. . .	
District of Columbia			81	E, M, S	M, S	E, M, S	
Florida			67	E, M, S	E, M, S	E, M, S	10
Georgia	Major[c]		61	E, M, S	E, M, S	E, M, S	
Hawaii			62	. . .	. . .	. . .	
Idaho	Major and minor		56	E, S	E, S	No	6 sem. hrs.
Illinois	Major[c]		64	E, M, S	E, M, S	E, M, S	
Indiana	Major[e]		73	E, M, S	M, S	E, M, S	9
Iowa	Major[e]		69	E, M, S	M, S	. . .	12
Kansas	Major[c]	Major[c]	64	E, M, S	E, M, S	E, M, S	12
Kentucky			60	No	No	No	12
Louisiana	Major and minor	Minor	48	E, M, S	E, M, S	E, M, S	9[a]
Maine	Minor		58	. . .	. . .	. . .	15
Maryland	Major[c]		68	E, M, S	E, M, S	E, M, S	20[a]
Massachusetts			70	E, M, S	E, M, S	E, M, S	5[a]
Michigan	Major and minor		54	E, S	E, S	. . .	6
Minnesota			86	E, M, S	E, M, S	E, M, S	10
Mississippi	Major[e]		58	. . .	. . .	. . .	12
Missouri	Major	Minor	61	. . .	. . .	. . .	8 sem. hrs.
Montana	Major and minor		62	No	No	No	
Nebraska	Major		71	E, M, S	E, M, S	E, M, S	14
Nevada	Major[e]		57	. . .	. . .	. . .	8 sem. hrs.
New Hampshire	Major		72	. . .	. . .	. . .	15[a]
New Jersey	Major	Minor	74	. . .	. . .	. . .	15[a]
New Mexico	Minor	Minor	48	E, M, S	E, M, S	E, M, S	14
New York	Major		74	E, M, S	E, M, S	E, M, S	8[a]
North Carolina	Major[b]	Major[b]	76	. . .	. . .	. . .	10
North Dakota	Major[e]		65	. . .	. . .	. . .	10
Ohio	Major[c]		61	E, M, S	E, M, S	E, M, S	
Oklahoma	Major	Minor	53	. . .	. . .	. . .	12
Oregon			58	E, M, S	E, M, S	E, M, S	15
Pennsylvania	Major[c]		72	E, M, S	E, M, S	No	12
Rhode Island	Major		77	E, M, S	E, M, S	. . .	
South Carolina			74	E, M, S	E, M, S	E, M, S	12

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Table 1. Illustrative Attributes of Teacher Preparation Programs Required for State Certification—*Continued*

State	Content knowledge: Subject-area requirements for beginning teachers: High school	Content knowledge: Subject-area requirements for beginning teachers: Middle school	Content knowledge: Percent of secondary teachers who majored in their core academic subjects in 2000	Pedagogy: Nature of students' learning process	Pedagogy: Subject-area pedagogy	Pedagogy: Classroom management	Field experience: Minimum student teaching (weeks)
South Dakota	Major[c,e]		57	. . .	. . .	. . .	10
Tennessee	Major[c]		57	E, M, S	E, M, S	M, S	15
Texas			53	. . .	. . .	. . .	12
Utah	Major and minor		61	E, S	E, S	E, S	
Vermont	Major	Minor	65	E, M, S	E, M, S	E, M, S	12
Virginia	Major	Minor	66	E, M, S	E, M, S	. . .	5[a]
Washington			53	E, M, S	E, M, S	E, M, S	
West Virginia	Minor		59	. . .	. . .	. . .	12
Wisconsin	Major[c]	Minor	79	E, M, S	E, M, S	E, M, S	15[a]
Wyoming			64	. . .	. . .	. . .	8

Source: Data are from "Quality Counts at 10: A Decade of Standards Based Education," *Education Week* 25, no. 17 (2006): 86–87, except for pedagogy data, which are taken from the National Association of State Directors of Teacher Education and Certification. In pedagogy columns, E indicates elementary school requirement; M, middle school requirement; S, secondary school requirement; a blank cell indicates that no data have been submitted by the state.

a. The Editorial Projects in Education (EPE) Research Center converted requirements given in terms of hours, days, or semesters into weeks.

b. State requires teacher candidates to demonstrate subject-matter competency either by majoring in the subject taught or by passing a content test.

c. State does not stipulate how much coursework constitutes a major.

d. Colorado requires 800 hours of student teaching and other kinds of clinical experience. The EPE Research Center therefore based its estimate of minimum number of weeks required for student teaching on 400 hours.

e. State requires a major in the subject taught, but teachers can receive additional content-area endorsements if they obtain at least a minor in the subject.

and classroom management. Such material can be offered in free-standing courses or, when it is specific to a particular subject area, woven into a subject-matter course. Based on states' certification requirements there is substantial uniformity in many areas of pedagogy. As table 1 shows, 84 percent of states require preparation programs to present material on classroom management, and 83 percent require them to address subject-area pedagogy. Only four states have no specific pedagogy requirements. Nevertheless, pedagogy is a contentious area of teacher preparation. Some observers believe teacher preparation programs and state certification requirements place too much emphasis on pedagogy.[8] Others debate how to deliver pedagogic knowledge to teachers to have the greatest effect on student outcomes—either in the classroom or in field experiences, where prospective teachers can practice their skills.[9]

Thirty-eight states require beginning teachers to have field experiences, such as student teaching. But as the table indicates, state requirements on student teaching vary substantially. Some states require as few as five weeks, while others require fifteen to twenty weeks. Many observers believe that field experience is a crucial component of teacher preparation, especially when teachers are being prepared to teach in an environment with which they are not familiar.

Table 2. Illustrative Attributes of Alternative Route Programs and Assessment Required for State Certification

	Attributes of programs			Written tests required for initial license in 2005–06			
		Pre-service training		Subject knowledge			
State	Program for candidates with a B.A. in 2005–06	Minimum duration[a]	Practice teaching or fieldwork	Basic skills	High school	Middle school	Subject-specific pedagogy
Alabama	Yes[b]			Yes	Yes	Yes[c]	
Alaska	Yes[b]			Yes			
Arizona	Pilot	4 weeks			Yes		
Arkansas	Yes	2 weeks		Yes	Yes	Yes[c]	Yes
California	Yes	120 hours		Yes	Yes[d]	Yes[d]	Yes
Colorado	Yes				Yes		
Connecticut	Yes	8 weeks	Yes	Yes	Yes	Yes	Yes
Delaware	Yes	120 hours	Yes	Yes	Yes		Yes
District of Columbia	Yes[b]	7 weeks	Yes	Yes	Yes		Yes
Florida	Yes			Yes	Yes	Yes[c]	
Georgia	Yes	4 weeks	Yes	Yes	Yes	Yes	Yes
Hawaii	Yes		Yes	Yes	Yes	Yes	Yes
Idaho	Yes	9 credits and 30 hours			Yes		
Illinois	Yes		Yes	Yes	Yes	Yes[c]	Yes[e]
Indiana	Yes	18 credit hours	Yes	Yes	Yes		Yes
Iowa	Yes	12 credit hours	Yes				
Kansas	Yes[b]	2 credit hours			Yes	Yes	
Kentucky	Yes	8 weeks	Yes		Yes	Yes	
Louisiana	Yes	9 credit hours	Yes	Yes	Yes	Yes	Yes[e]
Maine				Yes	Yes		
Maryland	Yes	135 hours		Yes	Yes		Yes

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Alternative Routes

Alternative routes to certification typically allow teachers to enter the classroom by postponing or bypassing many of the criteria required by traditional teacher preparation programs. As shown in table 2, forty-six states and the District of Columbia report having at least one alternate route to certification.[10] All require teachers to hold a bachelor's degree; 80 percent require teachers to demonstrate subject matter knowledge by completing coursework or passing an exam, or both.

Although some states have long used alternate routes, more than half of such programs were created in the past fifteen years and more than a third were created after 2000. Some states and school districts rely heavily on alternate routes as a source of supply. New Jersey, Texas, and California get more than a third of their new teachers in this way, and alternate routes are a rapidly growing source of supply in many other states and school districts.[11] Often the growth of alternate routes reflects a shift away from emergency and temporary certification.

The requirements of alternate route programs vary greatly across states. Many alternative certification programs have both pre-service and in-service requirements. Some require as little as two weeks of pre-service

Table 2. Illustrative Attributes of Alternative Route Programs and Assessment Required for State Certification—*Continued*

	Attributes of programs			Written tests required for initial license in 2005–06			
		Pre-service training		Subject knowledge			
State	Program for candidates with a B.A. in 2005–06	Minimum duration[a]	Practice teaching or fieldwork	Basic skills	High school	Middle school	Subject-specific pedagogy
Massachusetts	Yes	7 weeks	Yes	Yes	Yes	Yes	Yes[e]
Michigan	Yes[b]			Yes	Yes		
Minnesota	Yes			Yes	Yes	Yes	
Mississippi	Yes	90 hours		Yes	Yes		Yes
Missouri	Yes	2 weeks		Yes	Yes	Yes	Yes
Montana	Yes	6 credit hours					
Nebraska	Yes[b]			Yes			
Nevada	Yes[b]	3 weeks		Yes	Yes		Yes
New Hampshire	Yes	1 week		Yes	Yes		
New Jersey	Yes	4 weeks	Yes		Yes	Yes	
New Mexico	Yes			Yes	Yes	Yes	
New York	Yes[b]	200 credit hours	Yes	Yes	Yes	Yes[c]	
North Carolina	Yes	2 weeks		Yes	Yes[d]	Yes[d]	Yes
North Dakota				Yes	In 2006–07	In 2006–07	In 2006–07
Ohio	Yes	6 credit hours	Yes		Yes	Yes	
Oklahoma	Yes			Yes	Yes		Yes
Oregon	Yes[b]			Yes	Yes	Yes[c]	
Pennsylvania	Yes[b]			Yes	Yes	Yes	Yes
Rhode Island							Yes
South Carolina	Yes	2 weeks		Yes	Yes	Yes	Yes
South Dakota	Yes	9 credit hours			Yes		
Tennessee	Yes[b]			Yes	Yes		Yes
Texas	Yes				Yes	Yes[c]	Yes
Utah	Yes				. . .[f]		
Vermont				Yes	Yes		
Virginia	Yes	180 hours	Yes	Yes	Yes	Yes	Yes[e]
Washington	Yes		Yes[g]	Yes	Yes		
West Virginia	Yes			Yes	Yes	Yes	Yes
Wisconsin	Pilot		Pilot[g]	Yes	Yes	Yes[c]	
Wyoming	Yes	9 credit hours					Yes

Source: See table 1.

a. Column indicates the minimum pre-service requirement for one or more of the state's alternative routes. States may have other alternative routes that require longer pre-service components.

b. At least one of the state's alternative routes requires participants to complete a traditional teacher preparation program while teaching.

c. At least some of the state's middle school teachers may pass one test that covers all core academic content areas, instead of tests specific to each subject area.

d. State requires teacher candidates to demonstrate subject-matter competency either by obtaining a major in the subject or by passing a content test.

e. States require only teachers of certain subjects, such as reading or technology, to pass subject-specific pedagogy tests.

f. Utah requires teachers to pass a content test to move from a Level 1 license to a Level 2 license, but prospective teachers need only take, not pass, content tests for initial licensure.

g. In Washington State and Wisconsin, participants in alternative routes are required to teach with their mentor teachers for at least a semester.

preparation, while others effectively require an academic year. More typically, pre-service ranges from four to twelve weeks during the summer before the new teacher enters the classroom and often includes pedagogy, methods of teaching, and field experiences. Fewer than half the states require practice teaching or fieldwork. In-service preparation typically involves coursework or mentoring, or both. Requirements for courses in education are common, but the nature and quantity of those courses vary widely.

A brief description of several alternate route programs illustrates some of the differences. Texas offers nearly 100 programs, of which ITeachTexas is typical. A statewide web-based program, it requires no onsite pre-service meetings. Eligible applicants must have a bachelor's degree with at least a 2.5 grade point average and must prove competency in reading, writing, and math either through coursework or minimum scores on standardized tests such as the ACT, SAT, or GRE. Once accepted, candidates have two years to meet the requirements for a standard teaching certificate. They must first complete a ten-part computer module, after which they are eligible to begin teaching. Finally, they must pass certification tests, including the appropriate subject-area test, complete the two-semester field experience, and secure recommendations from their mentor and campus administrator.[12]

The New York City Teaching Fellows Program, established in 2000, is the largest alternative route in the country. Only one in eight applicants becomes a teaching fellow. Applicants must have a bachelor's degree with at least a 3.0 grade point average. The summer before the school year begins, fellows must attend an intensive seven-week training session in which they observe and assist veteran teachers. Fellows must pass the basic skills and content-specialty certification exams before they can begin teaching. Once assigned a teaching position, they must begin an approved master's degree program that will qualify them for continuing certification in their subject area. Fellows now supply about 25 percent of new hires in New York City.

A relatively new approach to certification is the Passport to Teaching program of the American Board for Certification of Teacher Excellence (ABCTE). Initiated in 2004, the passport to teaching requires a professional teaching-knowledge exam and a subject-area exam. It is now recognized as a valid certification route by five states: Florida, Idaho, New Hampshire, Pennsylvania, and Utah.[13] Because it affords relatively low-cost access to the profession, it can increase supply significantly, but it puts heavy reliance on exams to ensure that applicants are qualified.

Alternative routes can alter substantially the composition of the teacher workforce, as the Teaching Fellows Program in New York City illustrates. In 2001 about half of all new teachers hired in New York City were uncertified; by 2004 that share had fallen below 10 percent, and it continues to fall. In short, New York City's uncertified teachers have been largely replaced by the teaching fellows.[14] Moreover, the teaching fellows' certification exam scores, undergraduate college rankings, and SAT scores on average substantially exceed those both of unlicensed teachers and of teachers prepared in traditional programs.[15] Teaching fellows are also on average a more diverse group than traditionally prepared teachers, with relatively more men and half again as many Hispanics and blacks. And the teaching fellows are more likely than traditionally prepared teachers to work in more difficult-to-staff schools.

Additional Certification

Of thirty-eight states responding to a survey by the National Association of State Directors of Teacher Education and Certification (NASDTEC), 82 percent offer second-stage certification, and 68 percent require it.[16] State requirements for second-stage certification vary. Eighty percent of the states that require such certification require additional teaching experience, 15 percent require teachers to have a master's degree, while 12 percent require some other form of additional coursework. Twelve percent require teachers to pass a state assessment.

In addition, forty-nine states recognize certification by the National Board for Professional Teaching Standards (NBPTS). Although no state requires national board certification, thirty-seven states provide financial incentives to encourage teachers to pursue the rigorous program, which is generally recognized as a standard nationwide for evaluating the knowledge and teaching skills of teachers.[17]

Certification Exams

States began testing teachers as a condition of employment during the 1960s. Since then, they have increasingly used exams to assess whether teachers have the minimum skills needed to enter teaching. States give four different types of tests: basic skills, liberal arts general knowledge, subject-matter knowledge, and pedagogic skills; some tests cover combinations of these topic areas. Of the states responding to the NASDTEC survey, 71 percent require a basic skills exam; 90 percent, a subject-matter exam; and 65 percent, a pedagogy exam. Fewer than 25 percent require a general knowledge exam. Most states requiring exams use the Praxis exam administered by Educational Testing Services (ETS). Typically, each type of test covers areas that reflect different skills identified as important for teachers. For example, the ETS professional knowledge test examines knowledge of how to plan instruction, implement instruction, evaluate instruction, and manage the learning environment.

States have different standards as to what constitutes a passing score on the exams. Even within states, passing scores change over time. Passing scores are typically determined by a panel of education experts who relate the minimum content knowledge and teaching knowledge required of a beginning teacher to knowledge demonstrated on the exam. Pass rates are typically in the 70–90 percent range, which is high relative to licensure exams in professions such as law, accounting, or medicine. Moreover, teachers typically may take the exam as many times as they choose—which raises the question of how many applicants the exam ultimately screens out.

How Preparation and Certification Affect Student Achievement

Depending on the path they take, people who enter teaching may meet many or few educational and testing requirements. In most states the route to teaching through traditional preparation programs can be arduous. In some states alternative routes may impose a lighter burden. What is the evidence regarding the effectiveness of these varying requirements in improving classroom teaching and student performance? Whether the varied components of teacher preparation or certification improve student outcomes depends on the relationship of these components to improved teaching and on the teacher hiring decisions that would be made in the absence of minimum requirements.

Teacher preparation and certification could improve student outcomes by several different paths. They could improve outcomes di-

rectly, by improving teaching, or indirectly, by providing information about teachers that is related to achievement. For example, requiring teachers to have more subject-area knowledge in math could enable them to teach math more effectively, thus improving student assessments in math. But that same requirement could also identify difficult-to-measure attributes, such as motivation and persistence, that are related to becoming a more effective teacher. Certification requirements could improve student outcomes if they delineate minimally qualified teachers and if, in their absence, hiring authorities would not hire the best candidates. The requirements thus constrain districts to hire at least minimally qualified teachers.

But because teacher preparation represents a substantial cost to individuals, both in terms of expenses, such as tuition, and in terms of the time needed for coursework, which could have been used for other activities, such as employment, it may reduce the supply of teachers. Preparation in state-approved programs does indeed provide some evidence that a teaching candidate has a minimal set of knowledge and skills. But if hiring authorities can determine independently which teaching candidates can most improve student achievement, then eliminating the requirement for teacher preparation could improve student outcomes by expanding the pool of candidates. Thus the net effect depends on a trade-off: the gain in student outcomes that results from teacher preparation weighed against the loss in student outcomes that results when authorities cannot hire people who have not met preparation requirements but who could nonetheless be effective teachers.

A similar argument holds for certification exams. These exams put a floor under the measured knowledge individuals must have to become certified. If the exams identify good teachers more effectively than hiring authorities can in the absence of the exams, then they could improve student achievement. But if the exams make distinctions based on knowledge that is not closely related to student outcomes, or if they classify individuals erroneously, they could exclude applicants who would be more effective teachers, thereby reducing student outcomes.

As a final note, the effect of preparation requirements and certification exams on teaching and student outcomes will be felt most directly in the most difficult-to-staff schools. Abundant evidence that teachers are sorted by their certification requirements across schools indicates that schools with the poorest or lowest-performing students have the least qualified teachers.[18] Higher-performing suburban schools will be relatively unaffected by the differential effect of preparation and exam requirements.

Assessing How Preparation and Certification Affect Student Achievement

The extent to which teacher preparation and certification improve the quality of teaching is an empirical question. Answering it requires focusing on questions in four key areas: teacher preparation, certification exams, teacher supply, and hiring.

First, to what extent do the knowledge and skills provided in teacher preparation programs improve teachers' ability to raise achievement for students? Some aspects of preparation, such as content knowledge, may be more important for student outcomes than others. What is the evidence for each of the components of preparation?

Second, how effective are certification exams in distinguishing between teachers who are adequate and those who are inadequate at improving student outcomes? Are the knowledge and skills tested on certification exams the same as those that raise student achievement? If so, to what extent do the exams reliably test that information and distinguish among candidates?

One reliable way to identify the effects of certification and teacher preparation on students' educational gains is through experiments in which teachers are randomly assigned to students.

Third, does the requirement that teachers be certified, with all that entails, deter some people from becoming teachers who could have improved student outcomes? If so, to what extent?

And finally, how effective are local hiring authorities in recognizing the attributes that will make applicants effective teachers? First, to what extent are hiring authorities assisted by the information about teacher quality provided by teacher preparation and certification? Second, to what extent do certification requirements constrain hiring authorities who would otherwise have hired less competent teachers?

Interpreting evidence on how teacher preparation and certification affect student achievement requires care. First, as noted, relatively little is known about the specific content or quality of teacher preparation programs. Most of the empirical work is thus based on proxies, which at times may not be closely linked to the concept of interest. Second, the usual caution in social science not to interpret correlational relationships as causal relationships warrants particular attention in this instance, because of the well-documented and systematic sorting of students and teachers, with the least-qualified teachers teaching the lowest-performing students within and across school districts.[19] Because more qualified teachers are much more likely to teach students who perform well, researchers must be careful in attributing better student outcomes to the high qualifications of teachers. For example, if teachers in schools where students perform best in math are more likely to be certified in math, one might be tempted to conclude that being certified to teach math contributes to higher student achievement. But in reality the teachers may be in schools where students perform well in math because these teachers prefer to teach good students and because employers want to staff their courses with in-field certified teachers. Finally, the forces that lead some states to have more rigorous certification policies may also cause those states to have accountability programs for students and teachers that could also affect student outcomes. Unless they take these other factors into account, analysts might mistakenly conclude that student achievement is being affected by certification, when instead it reflects some other effects.

One reliable way to identify the effects of certification and teacher preparation on students' educational gains is through experiments in which teachers are randomly assigned to students. Although experimental design is increasingly popular in education research, few such experiments have ad-

dressed the issues raised in this review.[20] As an alternative, researchers can rely on quasi-experiments. In certain cases, for example, a real situation comes close to random assignment. In other cases, statistical methods can control for teacher and student sorting. Although a complete description of the research methods that address the issue of teacher and student selection is beyond the scope of this article, suffice it to say that using rigorous standards of causal modeling calls into question much of the research on the effects of teacher certification and teacher preparation on student outcomes. However, there are some notable exceptions. For example, as described in greater detail below, recent research using extensive administrative data and sophisticated methods isolates the effects of teacher certification requirements on student value added.

Several analysts have recently reviewed research on whether and how teacher certification and preparation affect student outcomes.[21] We organize the evidence drawn from these reviews around questions in the four areas set out above: preparation, certification exams, teacher supply, and hiring.

Preparation

Research insights regarding the effects of graduate degrees and specific coursework on teachers' ability to improve students' outcomes have improved in recent years, but in general good evidence remains limited. Furthermore, the value of teacher preparation may well differ depending on the grade level or types of students being taught—issues to which typically little attention is paid.

Many studies find that the students of teachers with a graduate degree perform no better than those of teachers with only a bachelor's degree.[22] Other studies find both positive and negative effects of teachers' graduate degrees on student achievement.[23] More nuanced research examines the relationship between the field of graduate work and the subject matter taught and tested. For example, achievement in high school math is greater for students whose teacher has a graduate degree in mathematics than for students whose teacher either has no graduate degree or a degree in another subject.[24] Although it is plausible that subject-area graduate education could have such an effect, it is unclear whether the stronger performance of teachers with advanced degrees in math reflects their greater knowledge of math or simply their interest in math, which presumably predated and led them to graduate study and would have affected student performance even if they had no master's degree. Researchers have uncovered no evidence of similar effects of graduate work in English or science.

Because both graduate and undergraduate degrees can mask wide variation in subject-specific courses, several studies have focused on the number of subject-specific courses that teachers took. One such study finds no relationship between the number of college math courses a teacher took and the math gains of his fourth-grade students.[25] Others find that students of teachers with more math courses do have greater high school math gains, but the effects are generally small.[26] It could well be that the additional math courses make a difference for high school students but not for elementary school students. Similar research on the number of science courses is inconclusive, and researchers have not yet focused on other subject areas.[27] Thus the evidence provides some small support for the value of subject-specific coursework and graduate degrees, at least for teachers of high school mathematics. Given this

research base, the graduate coursework requirements in some states' certification systems, which impose large costs on teachers, and the incentives for graduate coursework in most school districts' salary schedules, which impose substantial costs on the districts, deserve greater scrutiny.[28]

The evidence for other areas of teacher preparation is even more tentative. As noted, an important component of virtually all certification and traditional teacher preparation programs is training in pedagogy. Most traditional teacher preparation programs contain multiple courses on aspects of pedagogy. Nearly all routes into teaching include some field experience, like student teaching, where pedagogical skills may be learned and practiced. And the first years of teaching provide important lessons on what works. Identifying the best way to prepare teachers to convey subject knowledge to various student audiences is complex and a matter of some dispute.[29] Research examining how students learn, together with the frequently replicated empirical observation that teachers' effectiveness improves over the first few years of their careers, offers at least indirect evidence that pedagogy is important.[30] Because pedagogy covers a number of distinct areas, it should be possible to discern the relative importance of various aspects of pedagogy by identifying the relationship of sub-scores on pedagogy exams or of specific coursework to student achievement.

Although research suggests that knowledge and skills regarding how to teach can influence student achievement, no study identifies either which of these skills are important or the best way for aspiring teachers to develop them.

To our knowledge, however, no research focuses on the relationship between certification exams in pedagogy and student achievement. Of the few studies that examine the relationship between pedagogy coursework and student achievement, none finds causal evidence and only a few provide even general correlational evidence. For example, one study finds that content-related pedagogy coursework in mathematics is positively linked with student achievement and is more closely linked with higher gains than is additional content coursework.[31] Although research suggests that knowledge and skills regarding how to teach can influence student achievement, no study identifies either which of these skills are important or the best way for aspiring teachers to develop them. Given the substantial investment most teacher preparation programs make in pedagogy, well-designed research in this area could be important.

Many close observers of teacher education believe that field experiences exert an important influence on teacher preparation. Once again, however, there is only limited research documenting any relationship between field experiences and student achievement, and none sorts out what particular content and duration of field experiences are most influential. As summarized by several studies, evaluations of field experiences typically focus on teachers' perceptions of how experiences are structured or self-identified changes in beliefs or practice.[32]

Numerous studies explore whether easily measured attributes of teacher preparation, such as having a master's degree, make a difference in student achievement. But the evidence on whether particular features of teacher preparation, such as the area of study or the extent and nature of content courses, affect student outcomes is much more limited. For policy at the state, school district, or teacher education program level to be informed, rigorous research examining the effectiveness of specific attributes of teacher preparation is essential. There is room for some optimism here, as several large-scale studies are now attempting to examine these relationships.[33] But what is most remarkable today is the lack of evidence on the effect of almost any aspect of teacher preparation on the performance of students.

Certification Exams

Certification exams are typically developed by a panel of experts who determine the passing level, or cut score, by relating minimum levels of content and teaching knowledge for beginning teachers to what is measured on the various exams. Two issues must be kept in mind in using such exams to assess the quality of teachers. First, the tests are not directly linked to student outcomes and thus may not be a good measure of how well a teacher will perform in the classroom. Second, the tests are designed to distinguish knowledge around the cut score and probably perform less well as a proxy for skills and knowledge as scores move away from that point. Because cut points for certification exams differ from state to state, it is possible to assess how scores, especially around the cut point, might affect student achievement. Moreover, in many states teachers who fail certification exams are allowed to teach as uncertified teachers, offering another opportunity to examine how the knowledge and skills measured by the exams affect student achievement.

A growing body of research is evaluating the extent to which certification exams are good signals of teacher effectiveness by examining the relationship between teachers' exam scores and the achievement gains of their students.[34] In general, this research finds that exam scores are positively linked to teacher effectiveness, but the size of the effect varies widely—probably because data were aggregated to different levels and because the studies failed to account for the sorting of teachers and students that may bias these effects.

Three recent studies address these issues with strong research designs and good data.[35] In both North Carolina and New York City, these studies find, performance on required certification exams is predictive of teachers' abilities to increase student achievement, especially in math, but exam scores affect student achievement less than, for example, teacher experience does. Thus the exams do distinguish among teachers, but only relatively weakly.

Overall, research suggests that requiring certification exams does not result in a higher proportion of "good" teachers' being selected but does reduce overall participation in teacher preparation.[36] Teachers in states with exam requirements have similar academic qualifications to teachers in states without them, although the qualification measures are limited and it is unclear whether unobserved attributes might differ. Research on how requiring the exam affects pursuit of education degrees is limited to a single cohort of teachers, and the effect is identified from differences across states, so this finding should be treated with care. These exams do

tend to disproportionately screen out minority teacher applicants.[37]

Teacher Supply

The problem in assessing whether requiring certification deters potentially effective teachers from entering the profession is observing what social scientists call the counterfactual—in this case, how the size and composition of the pool of teacher candidates would have differed without certification. All states certify teachers, and even in states where certification is least rigorous, the requirements can be meaningful. One study uses the variation across state certification requirements to examine whether the requirements reduce the likelihood that college graduates are education majors. It finds that more stringent certification course requirements do reduce the share of education majors, all else equal.[38] But this evidence, while suggestive, must be viewed with caution, given that the study observes the effect of differences in course requirements at a single point in time. These differences may be correlated with other differences across states that influence the likelihood of becoming an education major. In short, direct evidence on how certification affects the supply of teachers is lacking.

The extent to which alternative routes may affect teacher supply by producing teachers who perform well is one of the most pressing policy issues related to teacher preparation. Until recently, research on alternate routes did not compare the effects on student outcomes of teachers who reached the profession by different routes. Several such analyses, though, are now available.

One insight into how more lenient certification requirements might expand teacher supply comes from comparing the attributes of alternatively certified and traditionally prepared teachers. Nearly all alternative certification programs lower the cost of becoming a teacher, either by reducing the requirements that teachers must fulfill or by allowing teachers to complete requirements while earning a salary as a teacher, or both. Much of alternative certification is focused on attracting people into teaching who did not major in education and might never have been interested in doing so. Some alternative certification programs have been able to recruit teachers with stronger qualifications than those of traditionally prepared teachers. For instance, in 2003 Teach for America (TFA) had 16,000 applicants for 1,800 available slots and was therefore able to be highly selective in terms of teacher qualifications.[39] But even in the districts where TFA has its greatest presence, its teachers are a small fraction of the entering teaching workforce. Can alternate routes attract a significant share of entering teachers with strong qualifications?

As noted, teachers recruited in recent years to teach in New York City public schools through the New York City Teaching Fellows Program constitute about a quarter of all new teachers and have qualifications (for example, certification exam scores, undergraduate college rankings, and SAT scores) that on average substantially exceed those of teachers from traditional preparation programs.[40] But these mere facts are far from an analysis of how supply would be affected in the absence of certification. On one hand, New York City Teaching Fellows are given a stipend to subsidize their graduate education, likely inducing an increased interest independent of the reduced entry requirements. On the other hand, they must complete the same requirements as other teachers to receive their second-stage certification, likely dampening in-

terest in the program, since requirements have been delayed but not eliminated.

What is the evidence on the relative effectiveness of alternate route teachers? Because Teach for America places teachers in several states it is one of the most widely known alternative route programs, and several studies have analyzed differences in achievement among students taught by Teach for America teachers, traditionally certified teachers, and unlicensed teachers.[41] Their findings are similar, but differ somewhat depending on specification and the school districts examined. The most persuasive evidence suggests that, on average, students of entering TFA teachers perform at least as well in math as those of other entering teachers, including those from traditional preparation programs, but slightly worse in English language arts. With two or three years of experience, TFA teachers have student gains that are somewhat better than those of other teachers in math, and about the same in English language arts. Findings for the New York City Teaching Fellows are similar. New York requires alternatively certified teachers to complete a master's program in education, thus the TFA teachers and New York City Teaching Fellows are enrolled in education courses during their first three years of teaching. These evaluations bundle two characteristics of teachers—their general ability and their preparation to teach. As noted, TFA and the New York City Teaching Fellows Program strongly emphasize recruitment and selection, and their teachers have better general qualifications but receive substantially less pre-teaching preparation to teach. Thus, these findings may mean that the higher general qualifications of TFA and Teaching Fellow teachers initially offset the more substantial preparation of teachers following the traditional route.

It is important to note that to date, all the studies that have examined the effects of teacher preparation on student achievement have compared one program with another and they do not indicate performance in an absolute sense. Thus, all programs may be doing a fine job or all may be producing relatively weak gains in achievement. One study finds wide variation among teachers within each pathway, suggesting that much remains to be learned about what knowledge and skills in teachers best produce student achievement gains.[42]

Thus, these findings may mean that the higher general qualifications of TFA and Teaching Fellow teachers initially offset the more substantial preparation of teachers following the traditional route.

Hiring

Requiring state certification of teachers constrains local hiring to candidates who at least meet the certification requirements. Whether it improves or diminishes the quality of teachers hired depends on the ability and incentives of hiring authorities.

The degree to which localities discern teacher quality and act on that information depends on the ability of hiring authorities to identify teacher qualifications that signal ability to improve student outcomes. It also depends on the capacity of their human re-

source departments and the incentives they have to improve students' academic achievement. In many districts certification may have no effect at all in schools that teachers find attractive because these schools have an ample supply of applicants who would easily meet most certification requirements. Difficult-to-staff schools, though, have no such supply and have in the past hired many uncertified teachers. Enforcing certification requirements would force these schools to alter their hiring patterns. Thus, a promising research strategy is to examine hiring decisions in difficult-to-staff schools, where this effect is likely most keenly felt, especially under increased accountability for student outcomes.

Surprisingly little evidence is available on whether school systems make good selections among teacher applicants, and that evidence is mixed. One research study finds that teacher applicants who attend above-average colleges are significantly less likely to be hired than applicants who attend below-average colleges and that attributes such as undergraduate GPA and subject specialties have only a small effect on an applicant's probability of being hired.[43] But that research examines the attributes only of teachers who ultimately take jobs and does not distinguish between the attributes that employers value and look for in job candidates and the attributes of teachers who are willing to accept jobs. Highly qualified candidates may simply not be willing to teach in schools where less-qualified candidates accept jobs. Other research finds that employers prefer to hire teachers with better academic qualifications, such as higher scores on certification exams and a degree from a better undergraduate college.[44] Employers' weightings of job candidates are strongly related to higher scores on the teacher certification exam, especially in the range just above the exam cut score.

But recent evidence suggests that districts rely more on interviews and teacher credentials in making hiring decisions than on observations of teachers in the classroom. On the whole, new teachers report having had relatively few interactions with school-based personnel in the hiring process.[45] In addition, teachers were more frequently asked to submit transcripts, letters of reference, and resumes than portfolios and writing samples.[46] In many school districts, then, the hiring process is not likely to be good at distinguishing high-quality teachers, much less at providing a guarantee of hiring the best available teachers. Moreover, recently implemented accountability systems within each state may well change the incentives that school districts face to hire and retain the teachers most likely to improve student achievement. In sum, it is not possible to judge whether school districts' hiring decisions are helped or hurt by the constraint of being able to hire only certified teachers.

Policy Implications

In theory, strong teacher preparation and certification requirements can either improve or worsen student outcomes, depending on how well these requirements distinguish among more able teachers, on how they affect the supply of potential candidates, and on the ability and motivation of local hiring authorities. If more stringent requirements improve student achievement and deter relatively few potential teachers, then the requirements may well be good policy. Reduced certification requirements become more attractive as the effect of these requirements on student outcomes diminishes, the pool of prospective teachers who are deterred by the requirements grows, and the ability of schools to identify applicants who will produce good student outcomes increases. What evidence have researchers

produced to make it possible to evaluate these issues?

In the area of teacher preparation, substantial evidence suggests that general graduate preparation does little to improve student performance. Content knowledge in math contributes to student achievement in math, but little is known about other subject areas or about the quantity or focus of content knowledge that is relevant. Subject matter pedagogy may improve student achievement, but no evidence exists on most other aspects of pedagogy. Nor have researchers produced evidence that teacher field experiences affect student outcomes, although most teachers and other close observers see a strong link between the two. There is, however, evidence that highly selective alternative route programs can be a good source of qualified teachers.

As to certification exams, there is good evidence that teachers' scores on the exams have a modest positive effect on their students' achievement, with the best evidence of an effect in math. But without evidence on the supply effects of certification exams, the net effect remains in doubt.

In the area of teacher supply, there is modest evidence that teacher certification requirements shrink the pool of people who pursue teaching careers but virtually no evidence on whether shrinking the pool has had a meaningful effect on student outcomes.

And finally, in the area of hiring, the evidence suggests that schools have limited ability to identify in prospective teachers the attributes that allow them to improve student outcomes.

What are the policy implications of this research? In a few areas, evidence of how preparation and certification affect student achievement is relatively firm. In others, although little is known, circumstantial evidence provides some insights. In too many areas, though, the evidence is just too thin to have implications for policy. The lack of evidence should not, however, be interpreted to mean that potentially large effects do not exist. Given the enormous investment that is made by would-be teachers, education schools, school districts, and states in preparing and certifying teachers, and given the possibility that these requirements may reduce student achievement, the lack of convincing evidence in most of these areas is disturbing. The lack of an evidentiary base is important and has implications for both researchers and policymakers.

If more stringent requirements improve student outcomes and deter relatively few potential teachers, then the requirements may well be good policy.

The cost of ill-informed policy can be enormous. Consider, for example, a policy that requires all new teachers to have three credit hours (about forty-two classroom hours) of training in X before entering teaching. Based on estimates of the number of new teachers and the average wages of teachers, the cost of such a policy would exceed $250 million a year. If X can be shown to sufficiently improve outcomes for the students of these teachers after accounting for any reductions in supply, it is likely a good investment. If not,

these are resources that could well have been put to much better use. Compare the cost of this seemingly small policy intervention with the structure of teacher preparation and certification as a whole and it quickly becomes clear that better evidence could have an enormous effect on the use of scarce resources.

How are researchers and policymakers to move from the current state of knowledge of the effects of teacher preparation and certification to a more informed position from which good resource decisions can be made? Although there are hopeful signs that rigorous research developing causal connections between interventions and student outcomes is becoming more common, too often both researchers and policymakers fall short. Researchers often find it too costly, either in time or money, to develop data needed for convincing causal analysis. Policymakers often implement policy in ways that make evaluation difficult, if not impossible. Because most policies are developed and implemented by states and school districts, state and school officials should work much more closely with researchers as policies are contemplated. Both researchers and policymakers must thus change the ways they typically go about their work.

Notes

1. See H. Lankford and others, "Teacher Sorting and the Plight of Urban Schools: A Descriptive Analysis," *Educational Evaluation and Policy Analysis* 24, no. 1 (2002): 37–62.

2. See, for example, H. Peske and Kati Haycock, *Teaching Inequality: How Poor and Minority Students Are Shortchanged on Teacher Quality* (Washington: Education Trust, 2006).

3. "No State Meeting Teacher Provision of 'No Child' Law," *Education Week* 25, no. 38 (2006): 1, 16.

4. Research projects in Ohio, New York City, Louisiana, and Texas are collecting data on the structure and content of teacher preparation programs in those states.

5. See, for example, T. Kane and others, "What Does Certification Tell Us about Teacher Effectiveness? Evidence from New York City," unpublished paper (Harvard University, March 2006); and D. Boyd and others, "How Changes in Entry Requirements Alter the Teacher Workforce and Affect Student Achievement," *Education Finance and Policy* 1, no. 2 (2006): 176–216.

6. Information regarding traditional preparation program certification requirements is drawn from "Quality Counts at 10: A Decade of Standards Based Education," *Education Week* 25, no. 17 (2006): 85–86; and the online compilation of the National Association of State Directors of Teacher Education and Certification (NASDTEC) at www.nasdtec.org. The information in table 1 is illustrative; both Quality Counts and the NASDTEC site also show requirements for other certification components.

7. "Quality Counts" (see note 6).

8. See, for example, D. Goldhaber, "The Mystery of Good Teaching," *Education Next* (2002), no 1: 50–55.

9. See, for example, "Scholars Eye 'Signature' Method of Teacher Training," *Education Week* 25, no. 7 (2005): 8.

10. Ibid.

11. See the website of the National Center for Alternative Certification, *Teach-Now*, www.teach-now.org.

12. This material is drawn from the ITeach Texas website, www.iteachtexas.com/Timeline.cfm.

13. "ABCTE Study Finds Links between Tests and Student GPAs," *Education Week* 25, no. 37 (2006): 14.

14. Boyd and others, "How Changes in Entry Requirements Alter the Teacher Workforce and Affect Student Achievement" (see note 5).

15. Ibid.

16. These and the following statistics regarding second-stage certification are taken from the NASDTEC website, www.nasdtec.org.

17. "Quality Counts" (see note 6).

18. See Lankford and others, "Teacher Sorting and the Plight of Urban Schools" (see note 1).

19. Ibid. See also C. Clotfelter and others, "Teacher-Student Matching and the Assessment of Teacher Effectiveness," Working Paper 11936 (Cambridge, Mass.: National Bureau of Economic Research, 2004); D. Goldhaber, "Everyone's Doing It, but What Does Teacher Testing Tell Us about Teacher Effectiveness?" manuscript (University of Washington, 2006).

20. Below we discuss S. Glazerman and others, "Alternative Routes to Teaching: The Impacts of Teach for America on Student Achievement and Other Outcomes," *Journal of Policy Analysis and Management* 25, no. 1 (2006): 75–96. In addition, Mathematica Policy Research is currently using an experimental design to evaluate teacher induction programs.

21. See, for example, S. Wilson and others, *Teacher Preparation Research: Current Knowledge, Gaps, and Recommendations* (Seattle, Wash.: Center for the Study of Teaching Policy, 2001); A. Wayne and P. Youngs, "Teacher Characteristics and Student Achievement Gains: A Review," *Review of Educational Research* 73, no. 1 (2003): 89–122; M. Allen, *Eight Questions on Teacher Preparation: What Does the Research Say?* (Denver, Colo.: Education Commission of the States, 2003); M. Cochrane-Smith and K. Zeichner, eds., *Studying Teacher Education: The Report of the AERA Panel on Research and Teaching Education* (Mahwah, N.J.: Lawrence Erlbaum Associates, 2005).

22. For a summary of these studies, see E. A. Hanushek, "Assessing the Effects of School Resources on Student Performance: An Update," *Educational Evaluation and Policy Analysis* 19, no. 2 (1997): 141–64.

23. See R. Ferguson and H. F. Ladd, "How and Why Money Matters: An Analysis of Alabama Schools," in *Holding Schools Accountable: Performance Based Reform in Education,* edited by H. F. Ladd (Brookings, 1996), pp. 265–98; R. G. Ehrenberg and D. J. Brewer, "Do School and Teacher Characteristics Matter? Evidence from High School and Beyond," *Economics of Education Review 13* (1994): 1–17.

24. See D. D. Goldhaber and D. J. Brewer, "Does Teacher Certification Matter? High School Teacher Certification Status and Student Achievement," *Educational Evaluation and Policy Analysis* 22, no. 2 (2000): 129–45; D. D. Goldhaber and D. J. Brewer, "Evaluating the Effect of Teacher Degree Level on Educational Performance," in *Developments in School Finance*, edited by W. J. Fowler (National Center for Education Statistics, U.S. Department of Education, 1997), pp. 197–210; B. Rowan and others. "Using Research on Employees' Performance to Study the Effects of Teachers on Students' Achievement," *Sociology of Education* 70, no. 4 (1997): 256–84.

25. R. Eberts and J. Stone, *Unions and Public Schools: The Effect of Collective Bargaining on American Education* (Lexington, Mass.: Lexington Books, 1984).

26. D. H. Monk and J. A. King, "Multilevel Teacher Resource Effects in Pupil Performance in Secondary Mathematics and Science: The Case of Teacher Subject Matter Preparation," in *Choices and Consequences: Contemporary Policy Issues in Education*, edited by R. G. Ehrenberg (Ithaca, N.Y.: ILR Press, 1994), pp. 29–58; D. H. Monk, "Subject Matter Preparation of Secondary Mathematics and Science Teachers and Student Achievement," *Economics of Education Review* 13, no. 2 (1994): 125–45.

27. A small but growing literature examines the effects of teacher professional development on student achievement. Much of this literature finds positive effects, and some finds large positive effects; see J. Angrist and J. Guryan, "Teacher Testing, Teacher Education, and Teacher Characteristics," *American Economic Review* 94, no. 2 (2004): 241–46. Other research suggests the effects may be insignificant; see B. Jacob and L. Lefgren, "The Impact of Teacher Training on Student Achievement: Quasi-Experimental Evidence from School Reform Efforts in Chicago," *Journal of Human Resources* 39, no. 1 (2004).

28. There is limited research on the cost of graduate degrees for teachers. Knapp and others estimate that the cost of a master's degree to a full-time student is more than $42,000; see J. L. Knapp and others, "Should a Master's Degree Be Required of All Teachers?" *Journal of Teacher Education* 41, no. 2 (1990): 27–37.

29. P. Grossman, "Research on Pedagogical Approaches in Teacher Education," in *Studying Teacher Education: The Report of the AERA Panel on Research and Teaching Education,* edited by M. Cochrane-Smith and K. Zeichner (Mahwah, N.J.: Lawerence Erlbaum Associates, 2005), pp. 425–76.

30. See, for example, S. G. Rivkin and others, "Teachers, Schools, and Academic Achievement," *Econometrica* 73, no. 2 (2005); D. Boyd and others, "Complex by Design: Investigating Pathways into Teaching in New York City Schools," *Journal of Teacher Education* 57, no. 1 (2006): 156–66.

31. Monk, "Subject Matter Preparation of Secondary Mathematics and Science Teachers and Student Achievement" (see note 26). It should be noted that this analysis includes no controls for students other than the pre-test. Given that subsequent research has documented substantial sorting of teachers to particular student populations and that these student groups have substantial differences in achievement gains, the results should be interpreted with care.

32. Wilson and others, *Teacher Preparation Research* (see note 21); R. Clift and P. Brady, "Research on Methods Courses and Field Experiences," in *Studying Teacher Education: The Report of the AERA Panel on Research and Teaching Education,* edited by M. Cochrane-Smith and K. Zeichner (Mahwah, N.J.: Lawrence Erlbaum Associates, 2005).

33. For research under way in New York City, see D. Boyd and others, "Complex by Design: Investigating Pathways into Teaching in New York City Schools," *Journal of Teacher Education* 57, no. 1 (2006): 156–66; and www.teacherpolicyresearch.org. For research in Ohio, see T. Lasley and others, "A Systematic Approach to Enhancing Teacher Quality: The Ohio Model," *Journal of Teacher Education* 57, no. 1 (2006): 13–21; and http://tqp.mvnu.edu. Research is just beginning in Louisiana and Florida.

34. See R. F. Ferguson, "Paying for Public Education: New Evidence on How and Why Money Matters," *Harvard Journal on Legislation* 28, no. 2 (1991): 465–98; R. F. Ferguson, "Teachers' Perceptions and Expectations and the Black-White Test Score Gap," in *The Black-White Test Score Gap,* edited by C. Jencks and M. Phillips (Brookings, 1998), pp. 273–317; Ferguson and Ladd, "How and Why Money Matters" (see note 23); R. P. Strauss and E. A. Sawyer, "Some New Evidence on Teacher and Student Competencies," *Economics of Education Review* 5, no. 1 (1986), pp. 41–48; Goldhaber, "Everyone's Doing It" (see note 19); Clotfelter and others, "Teacher-Student Matching and the Assessment of Teacher Effectiveness" (see note 19); C. Clotfelter and others, "How and Why Do Teacher Credentials Matter for Student Achievement?" working paper, Duke University (2006).

35. Goldhaber, "Everyone's Doing It" (see note 19); Clotfelter and others, "How and Why Do Teacher Credentials Matter for Student Achievement?"(see note 34); D. Boyd and others, "The Narrowing Gap in New York City Teacher Qualifications and Its Implications for Student Achievement in High-Poverty Schools," working paper, University at Albany, SUNY (2006).

36. See Angrist and Guryan, "Teacher Testing, Teacher Education, and Teacher Characteristics" (see note 27); E. Hanushek and R. Pace, "Who Chooses to Teach and Why?" *Economics of Education Review* 14, no. 2 (1995): 101–17.

37. Karen J. Mitchell and others, eds., *Testing Teacher Candidates: The Role of Licensure Tests in Improving Teacher Quality,* National Research Council (Washington, D.C.: National Academy Press, 2001); Angrist and Guryan, "Teacher Testing, Teacher Education, and Teacher Characteristics" (see note 27).

38. Hanushek and Pace, "Who Chooses to Teach and Why?" (see note 36).

39. Ashindi Maxton, Teach for America, e-mail communication, October 8, 2003.

40. D. Boyd and others, "How Changes in Entry Requirements Alter the Teacher Workforce and Affect Student Achievement" (see note 5).

41. M. Raymond and others, *Teach for America: An Evaluation of Teacher Differences and Student Outcomes in Houston, Texas* (Stanford, Calif.: Hoover Institution, Center for Research on Education Outcomes, 2001); L. Darling-Hammond and others, "Does Teacher Preparation Matter? Evidence about Teacher Certification, Teach for America, and Teacher Effectiveness," *Education Policy Analysis Archives* 13, no. 42 (2005): 1–47; Glazerman and others, "Alternative Routes to Teaching" (see note 20); Boyd and others, "How Changes in Entry Requirements Alter the Teacher Workforce and Affect Student Achievement" (see note 5); T. Kane, J. Rockoff, and D. Staiger, "What Does Certification Tell Us about Teacher Effectiveness? Evidence from New York City," manuscript, National Bureau of Economic Research (March 2006).

42. Kane, Rockoff, and Staiger, "What Does Certification Tell Us about Teacher Effectiveness?" (see note 41).

43. D. Ballou, "Do Public Schools Hire the Best Applicants?" *Quarterly Journal of Economics* 111, no. 1(1996): 97–134.

44. D. Boyd and others, "Analyzing the Determinants of the Matching of Public School Teachers to Jobs: Estimating Compensating Differentials in Imperfect Labor Markets," manuscript, University of Albany, SUNY (2005).

45. R. P. Strauss and others, "Who Should Teach in Our Public Schools? Implications of Pennsylvania's Teacher Preparation and Selection Experience," *Economics of Education Review* 19, no. 4 (2000): 387–414; E. Liu and S. Johnson, "New Teachers' Experiences of Hiring: Late, Rushed and Information-Poor," Next Generation of Teachers Working Paper (Harvard Graduate School of Education, 2003).

46. Liu and Johnson, "New Teachers' Experiences of Hiring" (see note 45); D. Balter and W. Duncombe, "Staffing Classrooms: Do Teacher Hiring Practices Affect Teacher Qualifications?" manuscript, Syracuse University, Center for Policy Analysis (2005).