

PREPARING TEACHERS

BUILDING EVIDENCE FOR SOUND POLICY

Committee on the Study of Teacher Preparation Programs
in the United States

Center for Education

Division of Behavioral and Social Sciences and Education

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE NATIONAL ACADEMIES PRESS
Washington, D.C.
www.nap.edu

THE NATIONAL ACADEMIES PRESS 500 Fifth Street, N.W. Washington, DC 20001

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This study was supported by Contract No. ED-05-CO-0012 between the National Academy of Sciences and the U.S. Department of Education; by Contract No. 20060517 with the Ewing Marion Kauffman Foundation; by Contract No. D07001 with the Carnegie Corporation of New York; by Contract No. 200700087 with The Spencer Foundation; and by the President's Fund of the National Research Council. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the organizations or agencies that provided support for the project.

Library of Congress Cataloging-in-Publication Data

Preparing teachers : building evidence for sound policy.

p. cm.

“Committee on the Study of Teacher Preparation Programs in the United States, Center for Education Division of Behavioral and Social Sciences and Education.”

Includes bibliographical references.

ISBN 978-0-309-12805-6 (pbk.) — ISBN 978-0-309-12996-1 (pdf) 1.

Teachers—Training of—United States.

LB1715.P727 2010

370.71'173—dc21

2010014539

Additional copies of this report are available from the National Academies Press, 500 Fifth Street, N.W., Lockbox 285, Washington, DC 20055; (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area); Internet, <http://www.nap.edu>.

Copyright 2010 by the National Academy of Sciences. All rights reserved.

Printed in the United States of America

Suggested citation: National Research Council. (2010). *Preparing teachers: Building evidence for sound policy*. Committee on the Study of Teacher Preparation Programs in the United States, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Charles M. Vest is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. Charles M. Vest are chair and vice chair, respectively, of the National Research Council.

www.national-academies.org

**COMMITTEE ON THE STUDY OF TEACHER
PREPARATION PROGRAMS IN THE UNITED STATES**

ELLEN CONDLIFFE LAGEMANN* (*Cochair*), Levy Economics Institute,
Bard College

KENNETH SHINE** (*Cochair*), Department of Health Affairs, University of
Texas

HERBERT K. BRUNKHORST, Department of Science, Mathematics, and
Technology Education, California State University at San Bernardino

MARGARITA CALDERÓN, Center for Research and Reform in Education,
Johns Hopkins University

MARILYN COCHRAN-SMITH, Lynch School of Education, Boston College

JANICE DOLE, Department of Teaching and Learning, University of Utah

DONALD N. LANGENBERG, Department of Physics, University of
Maryland

RONALD LATANISION, Exponent Consulting, Natwick, MA

JAMES LEWIS, Mathematics Department and Center for Science,
Mathematics, and Computer Education, University of Nebraska at Lincoln

DAVID H. MONK, College of Education, Pennsylvania State University

ANNEMARIE SULLIVAN PALINCSAR, School of Education, University of
Michigan

MICHAEL PODGURSKY, Department of Economics, University of Missouri

ANDREW PORTER, Graduate School of Education, University of
Pennsylvania

EDWARD SILVER, School of Education, University of Michigan

DOROTHY STRICKLAND, Graduate School of Education, Rutgers
University

SUZANNE WILSON, College of Education, Michigan State University

HUNG-HSI WU, Department of Mathematics, University of California,
Berkeley

JAMES WYCKOFF, Curry School of Education, University of Virginia

LYN COUNTRYMAN (liaison from Teacher Advisory Council), Price
Laboratory School, University of Northern Iowa

MICHAEL ALLEN, *Study Director (to 2006)*

LISA TOWNE, *Study Director (2006-2008)*

STUART ELLIOTT, *Study Director (since 2006)*

ALEXANDRA BEATTY, *Senior Program Officer (since 2008)*

TINA WINTERS, *Senior Research Associate (to 2008)*

PATRICIA HARVEY, *Project Assistant*

* Chair, starting January 2009.

** Resigned January 2009.

Preface

The quality of teachers is increasingly recognized as critical to student learning. Holding schools and teachers accountable for student performance is a key element of plans for improving public education and is likely to remain so as the No Child Left Behind legislation is updated. Yet while the education of public school teachers has been the subject of concern, it has not been a primary focus of standards-based reform efforts. This study was mandated by Congress to answer basic questions about teacher education and the research that supports it and to highlight the way forward.

The study had two objectives: (1) to pull together a disparate and uneven research base, so that policy makers can see clearly what is and is not known and (2) to propose a research agenda to fill the gaps in that knowledge base. Our focus was clearly defined: we examined initial preparation for reading, mathematics, and science teachers. That is, although teacher learning is best understood as a process that continues throughout teachers' careers—for example, through induction, mentoring, in-service professional development, and professional collaboration—our focus was the ingredients essential to preparing “well-started beginners.”

While preparation is undeniably important, other factors have significant influence on the strength of the nation's teaching force. The incentives that attract aspiring teachers, the status of the field, the compensation teachers can expect, the conditions in which they do their work, and their opportunities for professional advancement are just a few of the factors that

affect who becomes a teacher and who stays in the field. In a report more than 20 years ago, the Carnegie Task Force on Teaching as a Profession made a number of recommendations regarding teacher preparation, but it also clearly articulated the importance of seeing it as tightly integrated with other aspects of teachers' professional lives and other elements of the education system. Although our report is not intended to address all the issues related to teacher quality, we emphasize that effective teacher education is one necessary condition for ensuring the quality of the teaching force, but is neither the only condition nor a sufficient one.

Teacher preparation programs are turning out more than 200,000 new teachers every year, and those teachers are badly needed to fill vacancies in a field that has high turnover and a particular need for teachers prepared and willing to work with the neediest children. It is important to strengthen teacher preparation, not just because teachers make up one of the largest occupational groups in the United States, but also because they are asked to serve every child and family in the country. Their work is a basis for democratic citizenship, and they are at the heart of one of the central experiences of growing up—schooling. Nevertheless, teaching has never attained the same status as law or medicine, and the uneven quality of teacher preparation is a reflection of the ambivalence with which university scholars and others have historically viewed this female-dominated field. If that is to change, improving teacher preparation is vital.

We found many gaps in the knowledge base, but it is important also to highlight the considerable grounding we found for many types of guidance regarding the preparation of reading, mathematics, and science teachers. Our goal was to provide a dispassionate summary and objective analysis that will help policy makers debate alternatives and help teacher educators provide stronger preparation, while also providing guidance for much-needed research. Teacher education deserves careful, balanced scrutiny, and that is what we have worked to provide.

A number of individuals assisted us in our information gathering and analysis and we are very grateful for their thoughtful input and their time. At our first meeting, several people provided us with a variety of perspectives and information about a range of questions related to our charge: Joan Baratz-Snowden of the American Federation of Teachers; Vicki Bernstein of the New York City Department of Education and the New York Teaching Fellows Program; Jean Braxton, dean of the School of Education of Norfolk State University; Daniel Fallon of the Carnegie Corporation; Mary Hatwood Futrell of the School of Education and Human Development of George Washington University; Frederick Hess of the American Enterprise Institute; Deborah McGriff of Edison Schools; and Jon Snyder of the Bank

Street College. At another of our meetings several individuals assisted us in exploring methodological issues: Pamela Grossman, Nomellini Olivier professor of education at Stanford University; Karen Hammerness, a post-doctoral fellow at Stanford University; Raven McCrory of the Division of Science and Mathematics Education at Michigan State University; Susan Moore-Johnson, professor of teaching and learning at Harvard University; Stephen Raudenbush of the Department of Sociology at the University of Chicago; Kate Walsh, president of the National Council on Teacher Quality; and Robert Yinger, professor of educational studies and teacher education at the University of Cincinnati and research director for the Ohio Teacher Quality Partnership.

We held workshops to explore several issues in depth. The first addressed both teacher licensure and program accreditation and we gratefully acknowledge the assistance of presenters: Dan Goldhaber of the Center on Reinventing Public Education at the University of Washington; Peter McWalters of the Rhode Island Department of Education; Frank Murray, president of the Teacher Education Accreditation Council; Kara Schmitt, formerly of the Michigan Department of Consumer and Industry Services; Kathy Sullivan of the North Carolina Department of Public Instruction; J. Fredericks Volkwein of the Penn State Center for the Study of Higher Education; Judith Watkins of the Council for Higher Education Accreditation; and Arthur Wise, president of the National Council for the Accreditation of Teacher Education.

At our second workshop we explored two issues. One was the preparation of mathematics and science teachers, and we thank: Sybilla Beckmann, a professor of mathematics at the University of Georgia; Rodger Bybee of the Biological Sciences Curriculum Study; Elizabeth Davis of the Department of Applied Economics at the University of Michigan; James Hiebert of the School of Education at the University of Delaware; Barbara Miller of the Education Development Center; Paul Sally, director of undergraduate mathematics education at the University of Chicago; Mark Windschitl of the College of Education at the University of Washington; and Robert Yager of the College of Education at the University of Iowa. The second issue was perspectives on professions in the United States, and we thank: Steven Brint, a professor of sociology at the University of California, Riverside, and Lee Shulman of the Carnegie Foundation for the Advancement of Teaching.

We explored several state and regional analyses of teacher preparation by commissioning two studies, and we extend our sincere thanks to Tim Sass of Florida State University and to Pamela Grossman and her colleagues for their investigations of data from Florida and New York City, respectively. We also thank Douglas Harris of the University of Wisconsin at Madison;

George Noell of Louisiana State University; Kent Seidel and Robert Yinger, both of the University of Cincinnati; and David Wright of the California State University System for their contributions to the workshop.

Finally, the intellectual leadership demonstrated by costudy directors Lisa Towne and Stuart Elliott in guiding the committee's work was outstanding. The substantive and editorial contributions of Alexandra Beatty were of the highest quality and added significantly to the shape and eloquence of the report. The combined administrative support and responsiveness of Tina Winters and Patricia Harvey were also of the highest quality, and we are extremely grateful for all they did throughout the committee process. We would have no report without them. We also wish to note that the views expressed in this report are those of the committee, not the sponsors who generously supported our work.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the Report Review Committee of the National Research Council. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

We thank the following individuals for their review of this report: Deborah H. Cunningham, Educational Management Services, New York State Education Department; Robert E. Floden, Institute for Research on Teaching and Learning College of Education, Michigan State University; Carolyn D. Herrington, Department of Educational Leadership and Policy Studies, Florida State University; Paul W. Holland, Paul Holland Consulting Corporation; Kenneth Howe, School of Education, University of Colorado at Boulder; Roger Howe, Department of Mathematics, Yale University; Joseph Krajcik, School of Education, University of Michigan; Henry M. Levin, Economics and Education, Teachers College, Columbia University; P. David Pearson, Graduate School of Education, University of California, Berkeley; Penelope L. Peterson, School of Education and Social Policy, Northwestern; and Steven Rivkin, Department of Economics, Amherst College.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of this report was overseen by Diana Pullin, School of Education, Boston College, and Burton Singer, Emerging Pathogens Insti-

tute, University of Florida. Appointed by the National Research Council, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

Ellen Condliffe Lagemann, *Chair*
Committee on the Study of Teacher
Preparation Programs in the United States

Contents

Summary	1
How Teachers Are Prepared and Certified, 2	
High-Quality Preparation, 3	
Evaluating Effectiveness, 5	
A Model for Future Research, 5	
High-Priority Research Questions, 6	
Data Collection, 6	
Conclusion, 7	
1 Introduction	9
Committee Task and Report, 9	
One of the Largest Occupations in the United States, 12	
Characteristics of Teachers, 13	
A Brief History of Teacher Education, 15	
A Changing Student Population, 17	
2 Seeking Strong Evidence	21
Approaches to Research Design and Evidence, 21	
Causal Evidence, 24	
The Complexity of Analysis: An Example, 25	
Randomized and Quasi-Experimental Designs, 26	
Value-Added Models, 28	
Qualitative and Descriptive Analyses, 29	
Conclusion, 30	

3	Pathways to Teaching and Teacher Preparation Programs	33
	Pathways to Teaching, 34	
	Variety Within and Among States, 35	
	Variety Within Pathways, 38	
	The Effects of Pathways, 39	
	Programs Within Pathways, 42	
	Features of Teacher Preparation Programs, 44	
	Program Purpose, 44	
	Requirements for Subject-Matter Knowledge, 45	
	Requirements for Pedagogical and Other Professional Knowledge, 47	
	Field and Clinical Experiences, 50	
	Faculty and Staff Qualifications, 52	
	Unanswered Questions About Teacher Preparation, 54	
	Selectivity, 55	
	Timing of Professional Education, 59	
	Content and Characteristics of Teacher Preparation, 60	
	Tradeoffs Between Selectivity and Intensity, 60	
	Conclusion, 62	
4	Preparing Teachers for All Fields	65
	Subject-Matter Preparation, 66	
	Teaching and Learning, 66	
	Coursework, 68	
	Evaluation and Research Challenges, 70	
	Conclusion, 73	
5	Preparing Reading Teachers	75
	The Research Base, 76	
	Question 1: What Are Students Expected to Know and Be Able to Do to Be Successful Readers?, 77	
	Preventing Reading Difficulties in Young Children, 78	
	National Reading Panel, 79	
	International Reading Association, 80	
	Adolescent Readers and English-Language Learners, 81	
	Question 2: What Instructional Opportunities Are Necessary to Support Successful Readers?, 82	
	Question 3: What Do Successful Teachers Know About Reading and How to Teach It?, 84	
	Overview, 85	
	Teaching Adolescent Readers, 88	
	Teaching English-Language Learners, 89	

	Question 4: What Instructional Opportunities Are Necessary to Prepare Successful Reading Teachers?, 93	
	How Reading Teachers Are Currently Prepared, 95	
	State Policies, 96	
	Descriptive Studies, 98	
	Conclusions, 99	
6	Preparing Mathematics Teachers	103
	The Research Base, 105	
	Question 1: What Do Successful Students Know About Mathematics?, 105	
	Question 2: What Instructional Opportunities Are Necessary to Support Successful Mathematics Students?, 109	
	Question 3: What Do Successful Teachers Know About Mathematics and How to Teach It?, 112	
	Question 4: What Instructional Opportunities Are Necessary to Prepare Successful Mathematics Teachers?, 115	
	How Mathematics Teachers Are Currently Prepared, 118	
	State Requirements, 118	
	Coursework, 119	
	Conclusions, 123	
7	Preparing Science Teachers	125
	The Research Base, 126	
	Question 1: What Do Successful Students Know About Science?, 127	
	Science for All Students, 127	
	Science Standards, 129	
	Learning Progressions and the Big Ideas of Science, 132	
	Question 2: What Instructional Opportunities Are Necessary to Support Successful Science Students?, 133	
	Standards, 133	
	Other Sources, 134	
	Question 3: What Do Successful Teachers Know About Science and How to Teach It?, 137	
	Professional Standards for Beginning Science Teachers, 138	
	Other Sources, 141	
	Question 4: What Instructional Opportunities Are Necessary to Prepare Successful Science Teachers?, 143	
	How Science Teachers Are Currently Prepared, 145	
	Conclusion, 147	

8	Accountability and Quality Control in Teaching	153
	Accountability: An Overview, 153	
	Certification, Licensure, and Testing, 155	
	Certification, 155	
	Licensure, 156	
	Testing, 156	
	Program Approval, 158	
	Standards, 158	
	Accreditation, 159	
	Comparisons with Other Fields, 165	
	Conclusion and Recommendation, 169	
9	Summary and Research Agenda	173
	Summary: Teacher Preparation in the United States, 173	
	Content of Teacher Preparation Programs: Research Evidence, 175	
	Accountability, 177	
	Research Agenda, 177	
	The Relationship Between Characteristics of Teacher Preparation and Student Learning, 178	
	Content Knowledge, 180	
	Field Experience, 180	
	Quality of Teacher Candidates, 181	
	A Comprehensive Data Collection System, 182	
	Recommendations, 185	
	References	189
	Appendixes	
A	Dissent, <i>Michael Podgursky</i>	205
B	How Teachers Learn Critical Knowledge and Skills: Tracing One Example	207
C	Biographical Sketches of Committee Members	211

9

Summary and Research Agenda

In response to our broad charge, the committee examined many aspects of the complex and diverse set of institutions and programs through which the majority of the nation's teachers are prepared. The bulk of our report focuses on the first three questions in our charge, about the candidates who enter teacher preparation programs, the nature of the pathways and programs those candidates select, and the extent to which the content of teacher preparation is consistent with scientific evidence. The first part of this chapter provides a summary of our findings about teacher preparation in the United States.

There is no lack of writing on teacher preparation, yet there are many gaps in the research base. The fourth part of our charge was to make recommendations regarding future data collection that would provide useful, valid, and reliable information. The second section of this chapter presents our conclusions about the research base, and the final section presents our recommendations for future research.¹

SUMMARY: TEACHER PREPARATION IN THE UNITED STATES

We looked first for information about the first two parts of our charge, regarding the individuals who enter teacher preparation programs and their academic preparation, as well as the types of instruction and experiences

¹The numbering of the conclusions and recommendations below follows that in the chapters.

they receive. There is no system in place to collect data across the myriad teacher preparation programs and pathways in the United States. Thus, we can say little about the characteristics of aspiring teachers, the programs and pathways they follow, or the outcomes of their preparation. We found some information about general elements that most teacher preparation programs share, such as courses in pedagogy and the foundations of education and required fieldwork. We also found that both programs and pathways vary dramatically in their requirements, structure, and timing. Because of the paucity of systematic research as well as the enormous variation in virtually all aspects of teacher preparation programs and pathways, we cannot draw any specific conclusions about the characteristics of current teacher preparation programs.

Researchers have examined particular programs and pathways to look for differences among the people who pursue different routes, as well as differences in the effectiveness of graduates. The findings are slim. Some research suggests that there are differences in the characteristics of teacher candidates who are attracted to different pathways and types of programs. There is also some research that compares the outcomes for graduates of different kinds of programs. However, the distinctions among pathways and programs are not clear-cut, and there is more variation within categories such as “traditional” and “alternative”—and even within the category of master’s degree programs—than there is between the categories.

Conclusion 3-1: There is currently little definitive evidence that particular approaches to teacher preparation yield teachers whose students are more successful than others. Such research is badly needed. We believe that the highest priority research would be studies that examine three critical topics in relation to their ultimate effect on student learning:

1. comparisons of programs and pathways in terms of their *selectivity*; their *timing* (whether teachers complete most of their training before or after becoming a classroom teacher); and their specific *components and characteristics* (i.e., instruction in subject matter, field experiences);
2. the effectiveness of various approaches to preparing teachers in classroom management and teaching diverse learners; and
3. the influence of aspects of program structure, such as the design and timing of field experiences and the integration of teacher preparation coursework with coursework in other university departments.

Content of Teacher Preparation Programs: Research Evidence

The question of the extent to which the required course work and experiences in reading, mathematics, and science across teacher preparation programs are consistent with converging scientific evidence presented a somewhat different challenge for the committee. Within each of the three fields there is a range of material that is potentially relevant. This material includes a relatively small body of empirical studies that provide some evidence about the effects of particular kinds of instruction; it also includes an even smaller amount of evidence about the effects of particular approaches to teacher preparation.

The other kinds of research that are available include descriptive and qualitative studies, which explore many aspects of teaching and learning in the three subjects, as well as a substantial body of empirical work on learning and cognition, which has had an important influence on practice within each discipline. In addition, the professional organizations that provide leadership in the fields of reading, mathematics, and science have drawn on the available research and their own intellectual traditions and experience as educators to develop content and achievement standards for students, standards for teachers, and, in some cases, guidance or standards for teacher education.

Substantial work by educators and researchers has identified some strong arguments about the factors that are likely to influence teacher quality and student learning. Yet this work is only a starting point because the empirical evidence supporting the impact of these factors is limited. The research base varies across the three school subjects, and our conclusions about preparation in each field reflect these differences. Our discussions of the state of knowledge in these three areas also reflect the fact that we found no evidence in the literature that undermines the current recommendations of disciplinary experts, or calls into question the tradition, common to many fields besides education, of basing some decisions about professional education on such recommendations.

Reading

Conclusion 5-1: Successful beginning readers possess a set of foundational skills that enable them not only to continue growing as readers but also to progress in all academic subjects. A variety of instructional approaches that address these foundational skills can be effective when used by teachers who have a grounding in the foundational elements and the theory on which they are based.

Conclusion 5-2: It is plausible that preparation in the nature of the foundational reading skills and research-based instructional approaches would improve teachers' practice to a degree that would be evident in learning outcomes for their students. However, there is currently no clear evidence that such preparation does indeed improve teacher effectiveness or about how such preparation should be carried out.

Conclusion 5-3: There are very few systematic data about the nature of the preparation in reading that prospective teachers receive across the nation. The limited information that exists suggests that the nature of preparation of prospective teachers for reading instruction is widely variable both across and within states.

Conclusion 5-4: Little is known about the best ways to prepare prospective teachers to teach reading. Systematic data are needed on the nature and content of the coursework and other experiences that constitute teacher preparation in reading.

Mathematics

Conclusion 6-1: It is plausible that to provide students with the instructional opportunities they need to develop successfully in mathematics, teachers need preparation that covers knowledge of mathematics, of how students learn mathematics, and of mathematical pedagogy and that is aligned with the recommendations of professional societies.

Conclusion 6-2: Many, perhaps most, mathematics teachers lack the level of preparation in mathematics and teaching that the professional community deems adequate to teach mathematics. In addition, there are unacceptably high numbers of teachers of middle and high school mathematics courses who are teaching out of field.

Conclusion 6-3: Both quantitative and qualitative data about the programs of study in mathematics offered and required at teacher preparation institutions are needed, as is research to improve understanding of what sorts of preparation approaches are most effective at developing effective teachers.

Science

Conclusion 7-1: Systematic data are needed on the nature and content of the coursework and other experiences that currently constitute teacher preparation in science. Research is also needed to examine the

propositions regarding the teaching and learning of science contained in professional recommendations that have not been adequately examined empirically.

Accountability

This was the picture of what converging evidence suggests about teacher preparation, against which one might measure what is currently happening. However, there is very little systematic research about current practice in the preparation of reading, mathematics, and science teachers. The limited information we found does not support broad conclusions about the nature and content of current teacher preparation programs.

As we describe in Chapter 8, our investigations of these issues led us to consider the accountability system, which is designed to ensure the high quality of teacher preparation programs. The accountability measures in place are diverse, and the gaps in the data available are large. If accountability for teacher preparation is to become more effective, a major assessment of the current situation would be needed.

Recommendation 8-1: The U.S. Department of Education should sponsor an independent evaluation of teacher education approval and accreditation in the United States. The evaluation should describe the nature, influence, and interrelatedness of approval and accreditation processes on teacher education program processes and performance. It should also assess the extent to which existing processes and organizations align with best practices in accountability and offer recommendations for how they could do so more effectively in the future.

RESEARCH AGENDA

The last part of our charge was to make recommendations regarding a model for data collection that would provide valid and reliable information about the content knowledge, pedagogical competence, and effectiveness of graduates from the various kinds of teacher preparation programs. The base of empirical knowledge about teacher preparation is thin. We believe the way forward is to build on what has been done by drawing on the professional consensus in each academic field for promising hypotheses about which features of teacher preparation are most promising and to subject those hypotheses to rigorous research. We were asked to develop an approach to future research that would provide a firmer foundation for policy and practice in the future. We organized our response around two overarching needs:

1. improved understanding of the relationships between characteristics of teachers' preparation and students' learning, and
2. a comprehensive, coherent system for collecting data about teacher preparation.

In discussing these two needs, we offer our assessment of the most important questions to pursue and the most productive means for doing so. Our discussion and recommendations draw on a study we commissioned (Crowe, 2007) to examine the current status and quality of data systems, as well as analysis of the available data related to the questions in our charge.

The Relationship Between Characteristics of Teacher Preparation and Student Learning

An obvious question to ask about teacher education is whether particular ways of preparing teachers lead to measurable improvements in student learning. Many researchers have worked hard to establish such connections. In Chapter 2 we discuss why it is difficult to establish clear causal links between aspects of teacher preparation and outcomes for the students teachers teach after they have completed their training. Programs may differ in the types of candidates they attract and in the types of knowledge and skills that candidates acquire. Programs may also differ in whether and where their graduates teach (e.g., what kinds of schools; urban or rural) and how long they remain teachers. And programs almost certainly graduate people who have different capacities to use their knowledge and skills to improve their students' learning. Some programs may produce graduates who are more effective in some settings than others. We repeat as Figure 9-1 the model used in Chapter 2 to portray the complex interactions among different elements that influence teacher quality and student achievement.

Thus far, some attempts have been made to compare the learning of students whose teachers were prepared in one way to that of students whose teachers were prepared in a different way. Unfortunately, we found that the existing studies have generally been insensitive to the details of teacher preparation that are most likely to result in differences in quality. Theoretically, the best way to do this sort of investigation would be experimental field trials, in which teacher candidates are randomly assigned to different programs and students are randomly assigned to program graduates. When randomization is not possible, however—which is frequently the case in studies of education and other complex human behaviors (see Chapter 2)—other means of estimating the effects that programs have on participants and their students can provide valuable information. Other approaches include regression discontinuity designs, instrumental variables, or natural

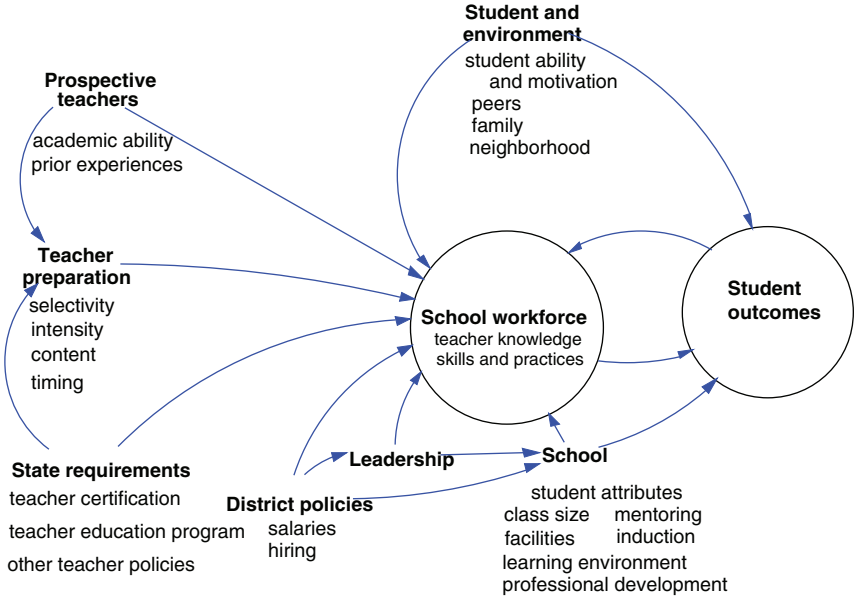


FIGURE 9-1 A model of the effects of teacher preparation on student achievement. SOURCE: Adapted from Boyd et al. (2006, p. 159).

experiments with appropriate controls. Researchers are still in the process of working out an array of practical approaches to providing reliable answers to questions about teacher preparation.

Research in teacher preparation would also be much easier to conduct if researchers had better measures of student outcomes than standardized achievement scores in mathematics and reading. Although scores are readily available and easy to use, they provide incomplete measures of both students’ learning and the effects of teachers (though assessment issues differ across the school subjects). We also believe there is much to be learned regarding the links between teacher preparation and the knowledge and skills teachers display in the classroom. Recently, there has been substantial interest in the development of observational protocols that measure various domains of teaching that have been linked to student outcomes (e.g., Mashburn et al., 2007; Matsumara et al., 2008; Grossman et al., 2009). Observational protocols offer a vehicle for exploring the contributions of teacher preparation and evaluating teachers’ effectiveness.

A strong research program designed to illuminate the ways teacher preparation influences outcomes for students would include evidence drawn from a variety of different perspectives, with the goal of establishing not only whether a particular feature of preparation is important to student

outcomes, but also why it is important. At present, research has provided only a fragmented and limited picture of how characteristics of teacher preparation improve student outcomes.

In our judgment, the simplest and most effective way to produce a clearer picture would be to focus research on the aspects of preparation that have the highest potential for effects on outcomes for students. Existing research provides some guidance on three aspects of teacher preparation that are likely to have the strongest effects: content knowledge, field experience, and the quality of teacher candidates.

Content Knowledge

There are strong reasons to believe that teachers need relevant content knowledge to be effective. Nevertheless, there is surprisingly little research that establishes clear and strong connections between teacher content knowledge and student learning. Throughout the report we discuss the challenges of isolating these connections—not only that the measures of both content knowledge and student learning are weak, but also that the relationships among learning, learners, classroom practice, and teacher preparation are complex. Nevertheless, we believe understanding how content knowledge influences student outcomes is very important.

The conclusions we drew about the research that was needed related to preparation in reading, mathematics, and science focus on this point. Looking across these three fields, we note several topics that would be fruitful for research:

- Clarify what is meant by teacher knowledge and how that construct can best be measured, and how content knowledge interacts with knowledge of the pedagogical application of that knowledge.
- Develop better measures of student learning of academic content.
- Establish the extent to which measures of teacher content knowledge can predict student learning.
- Conduct intervention studies in which teacher content knowledge is enhanced and the intervention group is compared with one or more control groups established by a rigorous research design, such as randomized trials.

Field Experience

Most observers agree that aspiring teachers should have field experience as part of their training. Yet reviews of previous research have failed to reveal any distinct relationships between the way field experiences are structured and implemented and teacher effectiveness. Recent work sug-

gests that teachers benefit from preparation programs that provide significant oversight of field experiences and from field experiences that are congruent with candidates' eventual teaching positions (e.g., Boyd et al., 2008a). Although this research is suggestive, there is no systematic causal evidence on what aspects of field experiences have the greatest effect on teacher effectiveness.

A substantial research program could be built around hypotheses regarding field experiences. A program that included theoretical work, qualitative analysis, statistical analysis, and randomized experiments could provide strong causal evidence of the effects and mechanisms by which various components of field experiences—such as coplanning, coteaching, scaffolded entry into practice, seminars with mentors, a mentor with relevant content and grade level experience, and the like—affect teachers' classroom practices and student achievement. For example, each primary component of field experiences could be systematically manipulated in a randomized control field trial to examine the relative effects on teacher classroom practices and student achievement outcomes.

It is also likely that statistical analysis that exploits the substantial differences in current practice would yield insights on relative effectiveness, although this analysis would require controls for selection effects. Qualitative analysis that examined the implementation of the field experience components would provide important insights on how and why these components may influence teacher effectiveness and could offer some suggestions on whether there may be important interactive effects. For example, one interactive effect that is worth examining is whether teachers who work in low-performing schools benefit more from certain field experiences than others.

Quality of Teacher Candidates

The quality of new teachers entering the field depends not only on the quality of the preparation they receive, but also on the capacity of preparation programs to attract and select academically able people who have the potential to be effective teachers. Attracting able, high-quality candidates to teaching is a critical goal, and there is reason to believe that some pathways and programs are much more attractive than others for such potential teachers. Less clear are the factors that attract the best candidates, the way program selectivity and preparation interact and the effect of each on student learning, and the extent to which the importance of these factors vary depending on the attributes (such as grade level and ability) of the students whom these teachers ultimately teach. That is, though some programs are more selective and attractive to academically accomplished candidates,

researchers have not clearly established whether those candidates make the best teachers.

A Comprehensive Data Collection System

A primary obstacle to investigating these and many other important aspects of teacher preparation is the lack of systematic data collection, at both the national and state levels. Crowe (2007) found that, apart from the methodological problems we have discussed, there is a problem with the “availability and quality of data about nearly everything having to do with teacher preparation” (p. 2).

The many basic questions that are at present difficult to answer systematically include the following:

- What are the characteristics of candidates who enter teacher preparation programs?
- How do those characteristics vary by program or pathway?
- Where do entrants and graduates of preparation programs ultimately teach?
- How long do teachers with different types of preparation continue to teach? Are differences in preparation associated with differences in teachers’ career trajectories?
- Where do teachers with different types of preparation teach?
- How do the knowledge and teaching practices of teachers with different types of preparation differ?
- What have been the effects of states’ policies regarding program approval and teacher certification?

A more comprehensive approach to data collection would provide both baseline monitoring of the status of teacher preparation (and improved opportunities to link that information with other aspects of the public education system) and a common foundation on which to build research efforts that investigate important aspects of teacher preparation. Moreover, it would provide the basis for much-needed national attention to the importance of teacher preparation and the urgency of improving it.

What would a more comprehensive approach look like? A comprehensive data system for teacher preparation would provide meaningful information about teacher candidates, preparation programs, practicing teachers, the schools in which those teachers teach, and the students they teach. For example, with respect to teachers, observational measures of their skills and practice would provide information about the content of preparation that goes beyond degree title, courses taken, or certifications attained. Similarly, with respect to students, the standardized performance

measures that many states currently use provide important information, but it will be essential to bring other kinds of information about student learning into the systems used to track trends and evaluate the effects of teachers. The assessment community has made important strides in developing richer measures of achievement, such as portfolios of student work and assessments that are embedded in classroom instruction and in developing ways to standardize them. Measures of other important aspects of learning, such as persistence and motivation, are also important, but at present these issues have a very limited presence in large-scale data collection efforts and accountability systems.

The new data would be integrated so that information about teacher candidates and their preparation could be connected with the knowledge, teaching practices, career paths, school environments, and student outcomes of the teachers who are prepared in different ways. One key to integration will be consistent definitions of key indicators. At present, states each develop their own teacher licensure categories (which may change from year to year), determine which assessments teachers must pass—and most use many different ones—and what performance level will constitute passing. States differ in the way they define teaching assignments and identify out-of-field teachers, and they even have differing ways of counting years of teaching experience. There are countless other sources of variation that make it extremely difficult for researchers to compare across states or generalize from the available information. Some information is also needed on a national basis because substantial numbers of teachers move among states during their careers.

A few states have developed exemplary systems for capturing data. Florida, for example, has the PK20 Education Data Warehouse (see <http://edwapp.doe.state.fl.us> [October 2009]), which is a nationally recognized model. This system collects comprehensive information about the entire educational system and has built-in linkages so that researchers do not need to create cross-files to investigate specific questions. Texas, Utah, and Louisiana are developing similar systems. Unfortunately, few states collect a significant amount of data about the teacher preparation programs and pathways that are not based in their university systems (Crowe, 2007).

The U.S. Department of Education has focused on the problem of education data. The Institute for Education Sciences (IES) awarded grants to 14 states in 2005 to develop “well-designed, comprehensive statewide longitudinal data system[s] with the capacity to follow individual students’ performance over time, to transmit student information both within and between States, and to provide educators and education researchers with the data needed to improve outcomes for students” (see <http://nces.ed.gov/Programs/SLDS/> [October 2009]). High-quality research on teacher education will require extending those data systems to information about

teachers, their background and education, preparation, and career paths across and within school systems.

At the national level, there are other data sources available, though none are linked to each other. They include a website maintained by the National Student Clearinghouse, which provides electronic verification of enrollment, degrees earned, and other information; the website of the National Association of State Directors of Teacher Education and Certification (NASDTEC), which lists approved college and university teacher preparation programs; a website mandated as part of the Title II of the 1998 Higher Education Amendments accountability system; the National Center for Education Information, which collects information on alternative routes; and the Core of Common Data (CCD), a project of the National Center for Education Statistics that collects a variety of relevant data on schools and students (Crowe, 2007).

The Data Quality Campaign (see <http://www.dataqualitycampaign.org/> [February 2010]) has examined the data collection systems in every state and developed a set of recommendations to guide states in collecting comprehensive longitudinal data from the entire educational system (preschool through higher education) and using it to improve student achievement. To provide trustworthy answers to the questions about the connections between teacher preparation and student learning for which this committee could not find answers, data collection related to teacher preparation that is integrated into this type of system would be extremely valuable. Useful data collection will cover all levels of the education enterprise, from local school districts to states and the federal government. This means that a data network, rather than a single monolithic data system is needed. The federal government can play a critical role in coordinating definitions and standards and helping to ensure that measures are common across the nation.

Ideally, there would be a high-quality, well-defined state data system in every state that gives explicit attention to collecting baseline information about teacher education and its effects. Each state data system would use variables defined in the same way and measured in the same way. The network would include data analysis files that allow researchers to perform secondary analyses to look for causal relationships among the natural variation in approaches to teacher preparation captured in the data file. Most states are now building such databases, and with a reasonably modest expenditure of money and effort they could be expanded to collect data on the individuals who enter different types of teacher preparation programs and the achievement of the students they later teach. A significant sum of federal money has recently been targeted for state data systems related to education as part of the American Recovery and Reinvestment Act of 2009. A key goal for this federal funding is to make data collection more efficient and integrated so that it can better support improvement: thus, it is an

ideal time to ensure that states incorporate information related to teacher preparation in their data collection efforts.

Finally, a targeted longitudinal nationally representative study—similar to those that the National Center for Education Statistics has conducted in other areas—would make it possible to track individuals from before they enter teacher education through their teacher education experiences and into the classroom. We recognize that designing such a study would be difficult, primarily because it is difficult to anticipate which high school students will ultimately pursue teacher education and become teachers. But the feasibility of such a study could be explored: if it proved feasible, it would provide important information that could not be learned from either a national indicator system or existing state databases.

Recommendations

In order for policy makers and teacher educators to have a stronger empirical basis for decisions about teacher preparation, a much clearer and more detailed picture is needed of teacher candidates and how teacher preparation is delivered, as well as a means of tracking changes in this picture over time. A body of evidence, developed from multiple perspectives and using an array of research designs, that establishes links between teacher preparation and learning—both teachers' learning and K-12 students' learning—would also be of great value to those who are responsible for teacher preparation. Some evidence would come from research intended to identify causal links between specific aspects of preparation and students' achievement. Other evidence would come from more systematic collection and analysis of both data about teacher candidates and the steps they take as they work to become teachers, and descriptive information about programs and pathways (such as analysis of accreditation materials, syllabi, course descriptions, and other program documents, as well as interviews and other observations).

Research on the link between preparation and teachers' knowledge of content and research-based instructional practices and frameworks and between preparation and teachers' skills and performance in classrooms would also be valuable. Some of this research would also examine the contexts in which teachers from various programs and pathways are more or less able to use the knowledge and research-based skills they develop during preparation and the conditions that support or constrain their capacity to use what they know.

There is currently almost no nation that is *not* concerned about teacher quality and teacher preparation. The conviction is widely shared that the economic health of a nation depends on the quality of its education system, which in turn depends directly on how teachers are selected, prepared, sup-

ported, and evaluated. The U.S. Congress has asked for answers to important questions about teacher candidates and the nature and quality of the preparation they receive. We offer two recommendations for building an empirical base to provide more complete answers to these questions:

Recommendation 9-1: The U.S. Department of Education should take the lead in coordinating existing data collection efforts and encouraging new ones, with the goal of developing a national education data network that incorporates comprehensive data related to teacher education.

Such a network would provide both baseline monitoring of the status of teacher preparation (and improved opportunities to link that information with other aspects of the public education system) and a common foundation on which to build research efforts that investigate important aspects of teacher preparation.

Ultimately, the kind of network we are recommending would include

- systems that provide integrated data within states using common definitions across states;
- a short-term national indicator system to monitor the status of teacher education; and
- a longitudinal, nationally representative study of teachers' career pathways beginning with their undergraduate education.

Recommendation 9-2: Researchers and those who fund research related to teacher preparation should focus on topics that have the highest potential effects on outcomes for students, specifically, research that explores the benefits of particular kinds of teacher knowledge and clinical experiences and the factors that affect the quality of entering teacher candidates.

Teacher preparation is a key element in the K-12 education system, not an isolated enterprise. It is affected by and affects every other element in the system. The logic of systemic standards-based reform of public education is very clear in calling for each element of the system to be aligned to consistent state standards. Data collection and accountability at the state level are critical to this alignment as well. Teacher preparation has not yet been brought into this alignment at the state level, but high expectations for teachers and for teacher preparation programs are a critical aspect of an aligned system.

The quality of the nation's teachers has been the subject of blistering critiques, as have the institutions that prepare teachers. Moreover, the preparation offered to aspiring teachers has long been characterized by inequity in both resources and opportunities. This report begins by highlighting how much teacher preparation matters, both to the long-term success of efforts to improve public education and to immediate outcomes for students. Policy makers, educational researchers, and scholars in relevant fields have shown a growing awareness of its importance and of the gaps in the knowledge base.

The critical questions about teacher preparation cannot be answered without the kind of nationwide coordination we call for. Clearer understanding of the content and character of effective teacher preparation is critical to improving it and to ensuring that the same critiques and questions are not being repeated 10 years from now.

