

Teacher Preparation Research: Current Knowledge, Gaps, and Recommendations

A Research Report
prepared for the
U.S. Department of Education
by the Center for the Study of Teaching and Policy
in collaboration with Michigan State University

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Technical Working Group

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EXECUTIVE SUMMARY

All children in the United States—no matter where they live or who they are—deserve qualified teachers. Yet many do not have them. Why?

There are serious disagreements about what it means for teachers to be well qualified and about what it takes to prepare teachers well. Opinions and exhortations about these questions abound, and decisions about teacher preparation are made on a variety of bases. The purpose of this report is to summarize what rigorous, peer-reviewed *research* does and can tell us about key issues in teacher preparation. Questions about subject matter and pedagogical preparation, clinical training, policy influences, and alternative certification have been examined through research, and the results can provide directions as we work to improve teacher preparation nationally.

Across the country, teachers are prepared in more than 1,300 large and small, public and private colleges and universities, as well as through alternative programs offered by districts and states. Program designs and teacher preparation vary widely. Although the population of U.S. school-age children is becoming increasingly diverse, our pool of potential teachers is not, furthering the need to prepare teachers to work with students different from themselves. The challenges in improving teacher education programs and practices in the U.S. are enormous, and a qualified teaching force is an unquestionable necessity. Research can help us make these improvements and build this qualified teaching force.

We examined more than 300 published research reports about teacher preparation and found 57 that met our criteria for inclusion in this summary. Reducing the complex findings of research studies to simple conclusions is risky business, and so our report is full of caveats. Individual studies cannot tell us definitively how to proceed with the improvement of teacher preparation—and only sometimes can the accumulated work in an area give clear direction for future action. Nonetheless, in this review we have found individual studies that identify important areas to be pursued and some collections of work that point toward how we can improve. The knowledge available from research, though uneven in some areas, lays promising groundwork for rigorous research to come.

What Answers Does Research Give To Critical Questions About Teacher Preparation?

This summary is organized around five major questions that address key aspects of teacher preparation. Overall, the research base concerning teacher preparation is relatively thin. The studies we found, however, suggest that good research can be done, but that it will take the development of more refined databases, measures, and methods, as well as complementary research designs that collect both qualitative and quantitative data.

Question 1: What kinds of subject matter preparation, and how much of it, do prospective teachers need?

It is no surprise that research shows a positive connection between teachers' preparation in their subject matter and their performance and impact in the classroom. Subject-specific methods courses in education are useful too. But, contrary to the popular belief that "more subject matter study is always better," there is some indication from research that teachers can acquire subject matter knowledge from various sources, including subject-specific academic coursework and study in an academic major. However, there is little definitive research on the kinds or amount of subject matter preparation; much more research needs to be done before strong conclusions can be drawn.

Some researchers have found serious problems with the typical subject matter knowledge of preservice teachers, even of those who have completed majors in academic disciplines. In mathematics, preservice teachers' knowledge of procedures and rules is often sound, while their knowledge of concepts and their reasoning skills may be weak. Lacking such deep understanding of fundamental aspects of the subject matter can impede good teaching, especially given the high standards called for in current reforms. Research suggests that changes in teachers' subject matter preparation may be needed, and that the solution is more complicated than simply requiring a major or more subject matter courses.

Question 2: What kinds of pedagogical preparation, and how much of it, do prospective teachers need?

By “pedagogical preparation” we mean the various courses that teachers take in such areas as instructional methods, learning theories, foundations of education, and classroom management. The content and arrangement of such courses in programs of teacher education varies widely. Studies that have looked across several of the pedagogical parts of teacher preparation programs reinforce the view that the pedagogical aspects of teacher preparation matter, both for their effects on teaching practice and for their ultimate impact on student achievement. Some evidence suggests that coursework in content methods matter for teacher effectiveness. But since many studies use a weak proxy for pedagogical preparation—possession of a teaching credential—the results give little insight into which aspects of pedagogical preparation are most critical.

Question 3: What kinds, timing, and amount of clinical training (“student teaching”) best equip prospective teachers for classroom practice?

Experienced and newly certified teachers alike see clinical experiences as a powerful—sometimes the single most powerful—element of teacher preparation. Research documents significant shifts in attitude among teacher candidates who work under close supervision in real classrooms with children. Whether that power enhances the *quality* of a teacher's preparation seems to depend on the specific intent and characteristics of the field experience. Field experiences are sometimes intended to show what the job of teaching is like, sometimes to help teachers learn about classroom management, and sometimes to give practical opportunities to apply concepts encountered in university coursework. Some are offered early in the program, others late. Duration, supervision arrangements, and settings vary dramatically.

Research shows that field experiences too often are disconnected from, or not well coordinated with, the university-based components of teacher education. Sometimes the field experiences are limited to mechanical aspects of teaching. Finding placements is challenging, and identifying schools that share educational perspectives with teacher education programs can be an issue. The norms of the schools in which prospective teachers are placed are crucial to shaping the experience. Yet research shows some promising practices can be developed: prospective teachers' conceptions of the teaching and learning of a subject matter can be transformed through their observations and analysis of what goes on in real classrooms. Stereotypical views can shift when student teachers work in classrooms that enable this to happen. In field experiences with focused, well-structured activities, more significant learning can occur. Cooperating teachers have a powerful influence on the nature of the student teaching experience.

Question 4: What policies and strategies have been used successfully by states, universities, school districts, and other organizations to improve and sustain the quality of preservice teacher education?

Too few research studies have been conducted to make confident conclusions about the effects of policies on the quality of preservice teacher education. The studies we examined suggest a basis for examining questions about revised certification systems, state approval mechanisms, and national accreditation and their desired effects on the preparation of teachers. In addition, research-based examinations of accountability systems, collaborative partnerships with K-12 schools, involvement of arts and science faculty as part of program policy, and school district incentives all might hold promise for the improvement of teacher-education program quality.

Question 5: What are the components and characteristics of high-quality alternative certification programs?

Until the early 1990s, most people who wanted to teach in the public schools needed to complete an undergraduate program of teacher preparation. By 1993, 40 states had created postbaccalaureate alternate routes into teaching, as a way of reducing shortages in critical areas such as mathematics and science, attracting non-traditional entrants, and finding staff for urban and rural schools. Recent data suggest that most states now have alternative routes firmly in place, although these differ dramatically in their designs.

Research indicates that alternative route programs have been successful in recruiting a more diverse pool of teachers. However, the research shows that alternative routes have a mixed record in attracting the “best and brightest,” challenging one rationale for the existence of alternative routes. The small number of interpretive studies available suggests that background in subject matter alone is not enough to prepare new teachers for the exigencies of contemporary classrooms. Alternative routes that have high standards for entry and require substantial pedagogical training, mentoring, and evaluation may be quite similar to traditional college-based teacher education and tend to be successful in their production of qualified teachers.

Future research will need to include more detailed descriptions of the various alternative route program structures and content before conclusions can be drawn about characteristics that make for quality programs. Research that compares the characteristics and performance of traditionally and alternatively prepared teachers over time will help clarify the complex issues around alternative programs.

Where Should Teacher Preparation Research Head?

The research we examined provides a starting point for efforts to better understand what would make for good teacher preparation. Most studies to date have looked at particular programs, courses, and students in single institutions. We now need to undertake studies that are designed to look across institutions, so that more general conclusions can be reached. As a beginning, studies that describe what goes on in the courses and programs of the more than 1,300 institutions that prepare teachers would be useful.

We need more studies that relate specific parts of teachers' preparation (subject matter, pedagogy, clinical experiences) to the effects on their teaching practice, and perhaps on student achievement. Studies that compare the relative importance of specific parts of teacher preparation could be useful to those designing and revising teacher education programs.

We recommend that future studies be designed to include more sensitive measures that describe specific features of program content and quality. Research programs should include comparisons among plausible alternatives. The interplay between research about particular contexts and research that seeks general conclusions across programs needs to be stronger. Teacher preparation research must be explicit about connections to the improvement of student achievement and about the contexts in which graduates of teacher preparation are working. Future research should also include longitudinal studies that examine the impact of teacher preparation over time, as well as the connections between teacher preparation, induction programs, and professional development opportunities.

Our review also suggests several potentially fruitful domains for future research. The subject matter preparation of teachers needs more attention, with close looks at both content and quality and at differences across subject areas. We do not yet know enough about the effects of close, long-term connections between K-12 schools and teacher preparation programs. Research could help us see how policies that are designed to influence teacher education actually affect program components and what prospective teachers learn. And, we need to know more about the effects of "education methods" and "education foundations" courses.

Strategic investment in research initiatives might also move us toward answers to the key questions more quickly. The educational research community has great interest in careful examination of local programs. Through funding for multi-site research programs, these individual efforts can be assembled into more powerful and crosscutting approaches to understanding teacher education. A small number of coordinated, large-scale studies could help provide a clearer picture of the national situation and increase the potential for linking features of teacher preparation programs with outcome data such as scores on teacher examinations. And, key for policymakers will be studies that help us learn about the conditions under which teacher education accountability systems lead to increases in teacher quality.

The potential of research to lead the ongoing reform and improvement of teacher education in the United States is enormous. By building on what we have done, and by conducting rigorous studies of important questions, the research community can do its part to ensure that a well-qualified teacher is available for every child, in every classroom.

INTRODUCTION

All children in the U. S.—no matter where they live and who they are—deserve qualified teachers. Few would disagree with this commitment. Yet many children do not have them. Why?

There are many answers to this question. Some would say that external forces—low salaries and status for teachers, for example—create the problem. Others argue that how we prepare and certify new teachers contributes to the problem. While no one argues for teachers who are less qualified, there are serious disagreements about what it means to be well qualified and what it takes to prepare teachers well. Commissions and professional societies are issuing an increasing number of recommendations concerning the practices and policies of teacher preparation, and such recommendations are also debated in scholarly circles. Groups as diverse as the National Research Council, the Fordham Foundation, and the American Federation of Teachers have issued reports concerning the future of teacher preparation in the United States.¹ Considerable debate has ensued concerning both how much we know about teacher preparation and what we should do.²

The U. S. Department of Education commissioned this report to summarize the existing research—empirical studies, conducted with rigor and critically reviewed by other researchers—on teacher preparation.³ For the purposes of this report, we focus on the preparation of prospective teachers, both in traditional teacher preparation programs and in alternative routes. We do not consider questions about the early years of inducting new teachers (after certification) or questions concerning professional development.

We should note here that *research* on teacher education is a relatively new field. The development of a sustained line of scholarship that examines the content, character, and impact of teacher education programs only began in the 1960s and gained momentum in the 1980s. In fact, with the exception of a brief period of time when the federal government supported teacher preparation research in the 1970s, there has been very little sustained funding for such research. A related problem concerns the lack of sufficiently rich databases to support high-quality research on teacher preparation. As will become clear, while the field does not lack exhortations about what teacher preparation *should* look like, there is much left to learn.

¹ See, for example, Chester E. Finn, Jr., Marci Kanstoroom, and Michael J. Petrilli, *The Quest for Better Teachers: Grading the States* (The Thomas B. Fordham Foundation, Washington, D. C., 1999); *What Matters Most: Teaching for America's Future* (National Commission on Teaching and America's Future, New York, 1996); *Educating Teachers of Science, Mathematics and Technology: New Practices for the New Millennium* (Committee on Science and Mathematics Teacher Preparation, National Research Council, National Academy Press, Washington, D. C., 2000); *Building a Profession: Strengthening Teacher Preparation and Induction* (Report of the K-12 Teacher Education Task Force, American Federation of Teachers, April 2000); and *Investing in Teaching* (National Alliance of Business, Washington, D. C., 2001).

² See, for example, Dale Ballou and Michael Podgursky, "The Case Against Teacher Certification," (*The Public Interest*, 132, pp. 17-29, 1998); Dale Ballou and Michael Podgursky, "Reforming Teacher Preparation and Licensing: What is the Evidence?" (*Teachers College Record*, Volume 102, pp. 28-56, 2000); and Linda Darling-Hammond, "Reforming Teacher Preparation and Licensing: Debating the Evidence," (*Teachers College Record*, Volume 102, pp. 5-27, 2000).

³ We recognize, of course, that research is not the only basis upon which decisions are made, especially in the matter of schooling where the future of U. S. children is at stake.

METHODS USED FOR THIS REPORT

The U. S. Department of Education commissioned this review on a short timeline—four months. We identified candidate studies by database searches, using relevant key words and searching ERIC, FirstSearch, Linguistic and Language Behavior Abstracts, Arts & Humanities Citation Index, Social Sciences Citation Index, and the Science Citation Index. We located additional studies by examining the reference lists of relevant meta-analyses, literature reviews, and reports. We also examined the tables of contents of prominent educational research journals and contacted researchers and teacher educators for their recommendations. We examined all handbooks of educational research for relevant chapters and reviewed the analyses, as well as reference lists. We consulted web sites related to teacher preparation—sponsored by advocates and critics alike—for relevant resources. We reviewed the references cited by teacher educators and critics of teacher education and the educational establishment. We asked scholars to review drafts of this report and to note studies that were missing. We also reviewed scholarship concerning educational research.⁴

Selection Criteria

With the advice of our Technical Working Group, we developed the following criteria for selecting research to include in our review. Research must be:

- *Directly relevant to the five questions posed by the U. S. Department of Education*—We were asked to focus on research concerning five questions, which we explain in the next section.
- *Published in a scientific journal*—We examined research published in journals that use independent peer review in deciding what research merits publication.^{5,6}
- *Published within the past two decades*—Some relevant research was conducted in the 1970s or earlier, but many audiences are concerned that the research would not apply today.
- *Studies of United States' teacher education*—Differences in how teacher preparation is structured and conducted across continents and countries made it difficult to synthesize across international studies in this review.

⁴ See, for example, Ellen Condliffe Lagemann, *An Elusive Science: The Troubling History of Education Research* (University of Chicago Press, Chicago, 2000) and Ellen Condliffe Lagemann and Lee S. Shulman (Eds.), *Issues in Education Research: Problems and Possibilities* (Jossey Bass and the National Academy of Education, San Francisco, 1999). For a view on the specific problems faced institutionally and historically by teacher education researchers, we looked to Kenneth Zeichner's "The New Scholarship in Teacher Education" (*Educational Researcher*, Volume 28(9), 1999, pp. 4-15) and Mary Kennedy's "The Problem of Evidence in Teacher Education" (in R. Roth (Ed.), *The Role of the University in the Preparation of Teachers*, Falmer Press, Taylor and Francis, Pennsylvania, 1999, pp. 87-107).

⁵ Our category of "scientific journals" included all journals listed as "peer reviewed" by the *Education Abstracts*. We also considered publications from the National Center for Education Statistics, the electronic journal *Education Policy Analysis Archives*, and several organizations with explicit and well-established peer review processes (Educational Testing Service, RAND Corporation, and the National Academies of Science).

⁶ Our review may have missed some research studies that were rigorously conducted but never reported in a peer-reviewed publication because journals are more likely to accept results that show some effect. As a consequence, some studies demonstrating little difference between programs or approaches might have been omitted by our selection process.

Once we located articles that fit these criteria, we used two other criteria to evaluate them:

- *Empirical*—offering evidence (quantitative, qualitative, or both) for conclusions, rather offering opinion, theory, or principles.
- *Rigorous*—meeting generally accepted standards in relevant research traditions. (See Appendix A for a description of the specific standards we applied to each of six traditions of research.)⁷

In short, we searched for research that would conform to what scholars characterize as “disciplined inquiry,” presentations of research that describe the methods of investigation and analysis, as well as the findings, well enough that others can assess its validity.⁸

Because we checked for empirical findings and evidence of rigor, many articles were not included in the final review. In the end, we looked carefully at 313 references, of which 57 are included in this review. Studies were discarded for four reasons: (1) they were not directly related to the questions; (2) they lacked sufficient rigor; (3) they consisted of arguments based on opinion or principles without empirical evidence; or (4) they were based on a single course in a particular teacher education program.⁹

Using these strict criteria meant that several important categories of literature were left out. For one thing, purportedly rigorous research published before our timeframe or in other sources were not included. Furthermore, research reviews and meta-analyses were excluded, since the original work on which these were based did not uniformly meet the criteria for inclusion in this review. For similar reasons, commission reports, articles in newspapers, and conference papers were also not considered. We also did not include essays on teacher preparation, which though they often offer important conceptual insights, are not relevant to a review focused exclusively on empirically grounded research. However, our review includes most of the rigorous empirical studies cited by authors of literature in these categories.¹⁰

We also did not include books, book chapters, monographs, and dissertations. We took this course reluctantly given that such writing occupies an important place in the literature on teacher preparation and often includes empirical work that has been carried out according to rigorous scientific standards.¹¹ We left these out for two reasons. First, books and dissertations are unevenly reviewed; some publishing houses and universities subject manuscripts to rigorous review approximating that of scientific journals, while many others do little or no review of the material’s scientific rigor. Second, a thorough and scientific review of such sources must consider *all possible* books, chapters, and dissertations, not just those that are the most well known, and must determine the nature of each publisher’s review process and the work’s rigor. A

⁷ Work on teacher preparation falls into six broad research traditions: experimental and quasi-experimental studies, correlational research, surveys (e.g., follow-up studies), interpretive studies (including case study investigations and other qualitative research), longitudinal change studies, and comparative population studies (e.g., comparing credentialed and non-credentialed teachers).

⁸ See, for example, Lee S. Shulman, “Disciplines of Inquiry in Education: An Overview” (In Richard M. Jaeger (Ed.), *Complementary Methods for Research in Education*, American Educational Research Association, Washington, D. C., 1988, pp. 3-17) and Lee J. Cronbach and Patrick Suppes, Eds. *Research for Tomorrow’s Schools* (Macmillan, New York, 1969).

⁹ This last category of study was discarded because it was difficult to synthesize studies that were that idiosyncratic. We discuss this issue when we consider Questions 2 and 3.

¹⁰ As we looked at other reviews of research on teacher preparation, we were struck by the relatively small number of citations to peer-reviewed reports of research. Many citations in such reviews were to conference papers, book chapters, committee reports, dissertations, position statements, and other research reviews. Given our criteria, we did not search out and read any citations that were listed as conference presentations, position statements, or dissertations.

¹¹ We also chose not to include reports that were sponsored by agencies with an obvious conflict of interest associated with the results. We were not questioning the validity of such work, but simply holding to our criteria that there had to be established processes for high quality peer review.

careful review of such sources is an enormous undertaking and well beyond the four-month scope of this effort. While a broader review is well worth doing, we are confident that our conclusions based on peer-reviewed sources would not differ substantially from the results of a broader review that included books and other reports.¹²

Furthermore, other bodies of research—on teacher recruitment, for example, or on preparing teachers to teach diverse students—are relevant to discussions of teacher preparation but do not answer the specific questions covered in this review. We did not include research on the relationship between teachers’ basic literacy and student achievement; teachers’ basic literacy is typically not part of a teacher preparation program per se.¹³ Teacher induction (which usually takes place in the first or second year of a new teacher’s career) and work on expert-novice contrasts are research domains that also have implications for teacher preparation but are not included here. Future research reviews ought to expand their focus to include some of these related areas, as well as a thorough review of relevant books.

FRAMEWORK FOR SYNTHESIZING RESEARCH ON TEACHER PREPARATION

There are many ways to think about teacher preparation. For this review, we were asked to consider five questions posed by policymakers, educators, and the public. The first two questions concerned critical components of teacher preparation: subject matter study and education coursework. We posed a central question in each domain and elaborated each with sub-questions.

Question 1: What kind of subject matter preparation, and how much of it, do prospective teachers need? Are there differences by grade level? Are there differences by subject area?

Question 2: What kinds of pedagogical preparation, and how much of it, do prospective teachers need? Are there differences by grade level? Are there differences by subject area?

Beside these program “content” areas, there are also significant questions to ask about program structures and policies. Teacher preparation programs, for example, also include “student teaching,” clinical or field experiences in real schools prior to certification, and so a question about this area is included. Given the heightened interest in proactive strategies that state departments of education, higher education institutions, and school districts might use to attract, educate, and retain qualified teachers, we also asked two other questions: one about research on successful policies, the other about research on alternatives to college-based teacher preparation, often called “alternate routes”:

¹² Although we did not include books in our findings, we did examine several books that are widely cited as significant reports about teacher preparation. Two of these books, John Goodlad’s *Teachers For Our Nation’s Schools* (San Francisco, Jossey-Bass, 1990) and Michael Fullan, Gary Galluzzo, Patricia Morris, and Nancy Watson’s *The Rise And Stall Of Teacher Education Reform* (American Association of Colleges for Teacher Education, 1998, Washington, DC) are addressed in a footnote in the discussion of Question 4 and compared to the work that did meet our criteria. Two other books, Rita Kramer’s *Ed School Follies: The Miseducation of America’s Teachers* (Free Press, New York, 1991) and Kenneth Howey and Nancy Zimpher’s *Profiles of Preservice Teacher Education* (State University of New York Press, Albany, NY, 1989), focused on description of programs, rather than presenting evidence about program effects. Thus, they did not address our focal questions.

¹³ See, for example, Ronald G. Ehrenberg and Dominic J. Brewer, “Did Teachers’ Verbal Ability and Race Matter in the 1960s: Coleman Revisited,” (*Economics of Education Review*, Volume 14, 1995, pp. 1-21); and Ronald F. Ferguson, “Paying for Public Education: New Evidence on How and Why Money Matters,” (*Harvard Journal on Legislation*, Volume 28, 1991, pp. 465-498).

Question 3. What kinds, timing, and amount of clinical training (“student teaching”) best equip prospective teachers for classroom practice?

Question 4. What policies and strategies have been used successfully by states, universities, school districts, and other organizations to improve and sustain the quality of pre-service teacher education?

Question 5. What are the components and characteristics of high-quality alternative certification programs?

A Cautionary Note

We begin with some cautions. First, as a recent report issued by the Educational Testing Service reiterates, teachers are prepared at widely varying institutions: large and small, public and private, colleges and universities. There is no single phenomenon, no monolith called “teacher preparation.”¹⁴ So while the phrase “teacher preparation” seems familiar to us all, it is falsely so, for teacher preparation means many different things across the United States. The same is true of alternative preparation programs, for they too vary in their content and complexity, length and structure.

Second, the goals of teacher education are contested, and there are multiple traditions within teacher preparation across the U. S. with different philosophies and emphases.¹⁵ We assumed that one crucial goal of teacher education is that teachers should be able to help all students meet academic standards, and we reviewed the literature accordingly. This is not the only goal of teacher preparation, and other reviews of the literature might take a very different perspective on the goals of teacher preparation and the questions researchers should investigate.

Third, this review focuses on *high-quality* teacher preparation. Judging quality involves judging effectiveness and impact. Researchers, teacher educators, and policymakers continue to wrestle with the question, “How should or can we measure the effectiveness of teacher preparation?” Some argue that we should use measures of student achievement to assess the quality of teacher preparation. While student learning is the ultimate goal of teacher preparation, many factors intercede, including school resources and students’ backgrounds. Researchers have made progress on developing methods that control for such variables, but much more progress needs to be made. Another way to answer the questions of quality involves considering measures of teacher performance. The relationship between teacher preparation and teacher behavior is less problematic to explore. Yet assessing teacher performance is also difficult, and researchers continue to wrestle with appropriate measures: teachers’ self report, supervisors’ ratings, and independent observations are among the measures used. Each measure is limited and future research will require the development of better databases, as well as more reliable measures.

¹⁴ Harold Wenglinsky, *Teaching the Teachers: Different Settings, Different Results* (Policy Information Center, Educational Testing Service, Princeton, N. J., 2000). See also C. Emily Feistritzer, *The Making of a Teacher: A Report on Teacher Preparation in the U. S.* (National Center for Education Information, Washington DC, 1999).

¹⁵ See, for example, Kenneth M. Zeichner, “Traditions of Practice in U. S. Preservice Teacher Education Programs” (*Teaching and Teacher Education*, Volume 9, 1993, pp. 1-13).

Fourth, as will become clear, the research base concerning teacher preparation is limited. We are, of course, not the first scholars to make this observation.¹⁶ The lack of depth of research on teacher preparation poses challenges for a review. With a limited number of studies, we cannot discuss trends. Yet descriptions of individual studies do speak to larger themes. In this report, we aim for a middle ground, offering summaries of some of the existing research, along with strategically selected studies that we describe in more depth to illustrate the complexities of answering each focal question. Specifics about the particular studies cited are available in Appendix B.

We conclude this introduction with an important and pressing need. As the population of U. S. school-age children becomes increasingly more diverse, our pool of potential teachers remains less so. We need to consider policies that increase the diversity of the teacher pool, and we need to prepare all teachers to teach children whose backgrounds are different than their own. Researchers have had little opportunity to investigate the implications of this shift in students and their teachers, and while a question concerning the preparation of teachers to teach diverse students was not a focal one in this review, we argue (in our recommendations for future research) that it ought to be central in the next generation of research on teacher preparation.

EXISTING RESEARCH ON TEACHER PREPARATION

Question 1. What kind of subject matter preparation, and how much of it, do prospective teachers need? Are there differences by grade level and subject area?

Findings

We reviewed no research that directly assessed prospective teachers' subject matter knowledge and then evaluated the relationship between teacher subject matter preparation and student learning. To date, researchers conducting large-scale studies have relied on proxies for subject-matter knowledge, such as majors or coursework. The research that does exist is limited and, in some cases, the results are contradictory. The conclusions of these few studies are provocative because they undermine the certainty often expressed about the strong link between college study of a subject matter area and teacher quality.

We found seven studies related to Question 1 that met our selection criteria.¹⁷ Four concerned mathematics and science teachers; one concerned secondary teachers without specifying subject matters; one concerned elementary and middle school

¹⁶ See, for example, Carolyn Evertson, Willis Hawley, and Marilyn Zlotnick, "Making a Difference in Educational Quality Through Teacher Education," (*Journal of Teacher Education*, Volume 36(3), 1985, pp. 2-12) and Daniel C. Humphrey, Nancy Adelman, Camille Esch, Lori M. Riehl, Patrick M. Shields, and Juliet Tiffany, *Preparing and Supporting New Teachers: A Literature Review* (U. S. Department of Education, Washington, D. C., September 2000).

¹⁷ Linda Darling-Hammond, Teacher Quality and Student Achievement: A Review of State Policy Evidence (*Education Policy Analysis Archives*, 8, <http://epaa.asu.edu/epaa/v8n1/> 2000). Patrick Ferguson and Sid T. Womack, "The Impact of Subject Matter and Education Coursework on Teaching Performance" (*Journal of Teacher Education*, Volume 44, 1993, pp. 55-63); Dan D. Goldhaber and Dominic J. Brewer, "Does Teacher Certification Matter? High School Teacher Certification Status and Student Achievement" (*Educational Evaluation and Policy Analysis*, 2000, Volume 22, pp. 129-145); Edith Guyton and Elizabeth Farokhi, "Relationships Among Academic Performance, Basic Skills, Subject Matter Knowledge, and Teaching Skills of Teacher Education Graduates" (*Journal of Teacher Education*, Volume 38, 1987, pp. 37-42); Parmalee P. Hawk, Charles R. Coble, and Melvin Swanson, "Certification: It Does Matter" (*Journal of Teacher Education*, Volume 36(3), 1985, pp. 13-15); David H. Monk, "Subject Area Preparation of Secondary Mathematics and Science Teachers and Student Achievement" (*Economics of Education Review*, 1994, Vol. 13, pp. 125-145); and Brian Rowan, Fang-Shen Chiang, and Robert J. Miller, "Using Research on Employees' Performance to Study the Effects of Teachers on Students' Achievement," (*Sociology of Education*, 1997, Volume 70, pp. 256-284). While there is other research that examines relationships between teacher knowledge and teaching performance or student achievement, we focused here on studies that had some direct relationship to teacher preparation.

mathematics and reading teachers; another studied program graduates who had taken subject matter knowledge tests. One study involved 36 teachers; the others had sample sizes ranging from 200 to 3,000 to 65,000 teachers. Measures of teacher subject matter knowledge ranged from self-reports of majoring in a relevant subject matter to the number of courses taken to National Teachers Examination (NTE) scores. (Brief descriptions of the studies mentioned in this report are available in Appendix B.)

- √ Consistent with common belief, several studies showed a positive connection between teachers' subject matter preparation and both higher student achievement and higher teacher performance on evaluations,¹⁸ particularly in mathematics, science, and reading.¹⁹ In another study, however, researchers found that NTE scores and grade point averages (GPAs) in the major accounted for only small proportions of the variance in teaching performance of prospective secondary teachers (by contrast, education coursework accounted for 48 percent and 39 percent of the variance when performance was rated by education supervisors and subject matter specialists, respectively).²⁰ In another study, the researcher found that states with a higher proportion of well-qualified teachers (full certification and a major in their field) had higher mathematics and reading test scores in grades four and eight. The same study found a negative relationship between a state's proportion of teachers with less than a minor in the field that they teach and student achievement.
- √ Undermining the view that the ideal preparation is a subject matter major, three relevant studies had complex and inconsistent results. One study found a positive relationship between teachers' degrees in mathematics and their students' test scores²¹ but did not find this relationship in science. Using the same data set, other researchers found a positive relationship between student achievement in mathematics and teachers' majors in mathematics, but the effect size was quite small.²² The third study found no effect of having a full mathematics major, though having coursework in mathematics did matter.²³ In the same study, there was a significant positive relationship between teachers' coursework in the physical sciences and student achievement gains for high school sophomores and juniors. Teachers' undergraduate coursework in the life sciences had no discernible impact on student performance.
- √ Contrary to the belief that "more is better," when it comes to subject matter courses, one study found that subject matter study beyond four to six courses had little effect on student achievement.²⁴ The same study found different relationships between amounts of preparation for life science teachers and physical sciences teachers and the effects their preparation had on student performance.

¹⁸ Darling-Hammond, 2000; Goldhaber and Brewer, 2000; Guyton and Farokhi, 1987; Monk, 1994. These results are supported with additional research that did not fall within the scope of this review, most notably D. H. Monk and J. King, "Multi-level teacher resource effects on pupil performance in secondary mathematics and science" (in R. G. Ehrenberg (Ed.), *Contemporary Policy Issues: Choices and Consequences in Education*, 1994, pp. 29-58, Ithaca, NY: ILR Press).

¹⁹ Goldhaber and Brewer, 2000; Monk, 1994.; Guyton and Farokhi, 1987; Rowan, Chiang, and Miller, 1997.

²⁰ Ferguson and Womack, 1993.

²¹ Goldhaber and Brewer, 2000.

²² Rowan, Chiang, and Miller, 1997.

²³ Monk, 1994.

²⁴ Monk, 1994.

Several studies addressed the question of the relative merits of studying subject matter in the context of *teaching* (for example, subject matter methods courses) versus studying it as a distinct course (for example, majoring in a subject matter).

- √ Several studies found that education coursework, including subject-specific methods courses, is useful.²⁵ One study found education coursework to be a better predictor of teaching performance than GPA in the major or National Teachers Examination Specialty score.²⁶ In another study, the researcher found that courses in undergraduate mathematics education contribute more to student gains than do courses in undergraduate mathematics.²⁷ However, other researchers found that having a degree in education had no impact on student science test scores.²⁸

Consider one study that illustrates the complexity of studying prospective teachers' subject matter preparation. In this study, the researcher found positive relationships between teachers' subject matter preparation and student achievement.²⁹ However, there was evidence of a "threshold effect"; that is, there was minimal additional effect of teachers' study of mathematics beyond five undergraduate mathematics courses on pupil mathematics performance. Having a mathematics major had no bearing on student performance. The results were different in science. While there was no impact on student achievement with teacher undergraduate coursework in life sciences, there was a strikingly positive relationship between undergraduate coursework in physical sciences and student achievement. Again, there appeared to be a threshold effect. After having taken four courses in physical sciences, there was less of a payoff in terms of student progress.

It is also important to note that the researcher found positive effects of mathematics education courses. Courses in undergraduate mathematics education contributed more to student achievement gains than did undergraduate mathematics courses. There was a similar relationship between coursework in science education and student achievement. After exploring a number of interaction effects, the researcher concludes that it is "risky" to make any generalizations about the significance of teacher subject matter knowledge.

While there is no definitive research that helps us understand this confusing finding, several possible explanations bear further investigation, including the possibility that a teacher needs to understand subject matter from a pedagogical perspective. Lee Shulman has called this form of professional teaching knowledge "pedagogical content knowledge."³⁰ We should be cautious here, however, in making strong claims, for "pedagogical content knowledge" remains more hypothesis than fact. We will return to this issue when considering related research concerning Question 2.

The research base tells us relatively little about differences across the subject areas or grade levels for which prospective teachers are preparing.

- √ The results in these few studies showed some differences between mathematics and science, as well as differences among areas of science as noted above. No conclusions can be drawn about other subject

²⁵ Ferguson and Womack, 1993; Guyton and Farokhi, 1987; Monk, 1994

²⁶ Guyton and Farokhi, 1987.

²⁷ Monk, 1994.

²⁸ Goldhaber and Brewer, 2000.

²⁹ Monk, 1994.

³⁰ Lee S. Shulman, "Those Who Understand: Knowledge Growth in Teaching" (*Educational Researcher*, Volume 15(2), 1986, pp. 4-14).

areas, because the only subject-specific research we found was in mathematics, science, and reading.

- √ There is very little information that sheds light on variations across grade levels because studies did not generally investigate grade-level differences.

In addition to the seven studies of the *effects* of subject-matter preparation, we found 11 studies concerning the *typical* subject-specific knowledge and beliefs of preservice teachers, at both the elementary and secondary levels.³¹ Research such as this bears indirectly on what teachers *should* know, for it helps illuminate the challenges faced in teacher preparation by pointing out what teachers *do not know* about the subject matter they will teach.

Three studies were based on one large-scale investigation that involved preservice teachers at universities across the country.³² The other studies were interpretive, with samples ranging from one teacher to more than 100. Two studies made comparisons between elementary and secondary teacher education candidates in mathematics,³³ and another looked at the growth of a student's understanding during a mathematics pedagogy course.³⁴ One study looked at the variations in historical knowledge of social studies teachers.³⁵

Although limited in number and scope, the studies suggest that the subject matter preparation that prospective teachers currently receive is inadequate for teaching toward high subject-matter standards, by anyone's definition. It appears that prospective teachers may have mastered basic skills, but they lack the deeper conceptual understanding that is necessary when responding to student questions and extending lessons beyond the basics. The research suggests that the limited knowledge of prospective teachers is acquired in coursework across a prospective teacher's K-12 and university experience—in high school, in general (liberal) education undergraduate requirements, and in relevant university subject-matter departments.

- √ In mathematics, both prospective elementary and high school teachers had relatively sound procedural, or rule-dominated knowledge of basic mathematics, especially in arithmetic but had difficulty when pushed to explain why an algorithm or procedure works. This was true of both education majors and mathematics majors.³⁶

³¹ Thomasenia Lott Adams, "Prospective Elementary Teachers' Mathematics Subject Matter Knowledge: The Real Number System" (*Journal for Research in Mathematics Education*, Volume 20, 1998, pp. 35-48); Deborah Loewenberg Ball, "Prospective Elementary and Secondary Teachers' Understanding of Division" (*Journal of Research in Mathematics Education*, 1990a, Volume 21, pp. 132-144); Deborah Loewenberg Ball, "The Mathematical Understandings that Prospective Teachers Bring to Teacher Education" (*Elementary School Journal*, 1990b, Volume 90, pp. 449-466); Hilda Borko, Margaret Eisenhart, Catherine A. Brown, Robert G. Underhill, Doug Jones, and Patricia C. Agard, "Learning to Teach Hard Mathematics: Do Novice Teachers and Their Instructors Give Up Too Easily?" (*Journal for Research in Mathematics Education*, 1992, Volume 23, pp. 194-222); Anna O. Graeber, Dina Tirosh, and Roseanne Glover, "Preservice Teachers' Misconceptions in Solving Verbal Problems in Multiplication and Division" (*Journal of Research in Mathematics Education*, 1989, Volume 20, pp. 95-102); G. Williamson McDiarmid and Suzanne M. Wilson, "An Exploration of the Subject Matter Knowledge of Alternate Route Teachers: Can We Assume They Know Their Subject?" (*Journal of Teacher Education*, 1991, Volume 42, pp. 93-103); Martin Simon, "Prospective Elementary Teachers' Knowledge of Division" (*Journal for Research in Mathematics Education*, Volume 24, 1993, pp. 232-254); Trish Stoddart, Michael Connell, Rene Stofflett, and Donald Peck, "Reconstructing Elementary Teacher Candidates' Understanding of Mathematics and Science Content" (*Teaching and Teacher Education*, 1993, Volume 9, pp. 229-241); Dina Tirosh and Anna O. Graeber, "Preservice Teachers' Explicit Beliefs about Multiplication and Division" (*Educational Studies in Mathematics*, 1989, Volume 20, pp. 79-96); Melvin (Skip) Wilson, "One Preservice Secondary Teacher's Understanding of Function: The Impact of a Course Integrating Mathematical Content and Pedagogy" (*Journal for Research in Mathematics Education*, 1994, Volume 25, pp. 346-370); Suzanne M. Wilson and Samuel S. Wineburg, "Peering at History through Different Lenses" (*Teachers College Record*, Volume 89, 1988, pp. 525-539).

³² Ball, 1990a, 1990b; McDiarmid and Wilson, 1991.

³³ Ball, 1990a and 1990b.

³⁴ M. Wilson, 1994.

³⁵ Wilson and Wineburg, 1988.

³⁶ Adams, 1998; Ball, 1990a, b; Borko, Eisenhart et al., 1992; Graeber, Tirosh, and Glover, 1989; McDiarmid and Wilson, 1991; Simon, 1993; Tirosh and Graeber, 1989; M. Wilson, 1994.

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- √ One study demonstrated that prospective elementary teachers have limited understanding of science, and another showed that prospective social studies teachers' knowledge of history varied considerably.³⁷
 - √ One study found that a prospective teacher's mathematical understandings of function concepts could develop in a specially designed mathematics education course.³⁸ However, another study found that, despite the good intentions of a mathematics methods instructor, the teacher education program did not create the conditions for a new teacher to overcome the limitations of her own knowledge of mathematics.³⁹
 - √ One study found that prospective social studies teachers had varying degrees of historical knowledge, despite the fact that they were all responsible for teaching history courses.⁴⁰

Recent interpretive research suggests that prospective teachers arrive in teacher education courses with limited subject matter knowledge. Several studies, as well as much of the public policy discussion, suggest that subject matter knowledge matters, yet—given the current research base—the question of “how much?” goes unanswered.

Weaknesses

All research is not created equal. Even published research continues to be scrutinized and debated.⁴¹ The research reviewed here is no different. Three weaknesses of the research regarding the subject matter preparation of prospective teachers are important to note.

First, as we have already said, the proxies for subject matter knowledge used in most current research are unsatisfying. Given the wide variation in what constitutes a “course” or a “major” across U. S. institutions of higher education, large-scale studies that investigate teacher knowledge are limited in how much they can tell us using such measures. We need more refined databases that include more accurate and sophisticated measures of teacher knowledge. Several studies used mathematics items to measure teacher knowledge.⁴² Future research needs to explore the development of these and other measures of teachers' subject matter knowledge.

The same is true of measures of teacher effectiveness. The studies vary in how they measured teacher effectiveness, using measures as wide-ranging as student achievement on standardized tests, supervisors' ratings, teacher self-reports, and independent observations. All of these measures have limitations. Student achievement is affected by many forces, not simply teacher preparation. Furthermore,

³⁷ Stoddart et al., 1993; Wilson and Wineburg, 1988.

³⁸ M. Wilson, 1994.

³⁹ Borko, Eisenhart, et al., 1992.

⁴⁰ Wilson and Wineburg, 1988. This result resonates with other research on teacher misassignment. See, for example, Richard M. Ingersoll, *Out-of-Field Teaching and Educational Quality*, (U. S. Department of Education, Washington, DC, 1996).

⁴¹ See, for example, the exchange of Dale Ballou and Michael Podgursky, “Reforming Teacher Preparation and Licensing: What Is the Evidence?” (*Teachers College Record*, 102(1) pp. 5-27, 2000) and Linda Darling-Hammond, “Reforming Teacher Preparation and Licensing: Debating the Evidence” (*Teachers College Record*, Volume 102, pp. 28-56, 2000).

⁴² Ball, 1990a, 1990b; Borko, Eisenhart et al., 1992; McDiarmid & Wilson, 1991; Rowan, Chiang, and Miller, 1997; and Simon, 1993. Many of the mathematics items were originally developed by Deborah L. Ball and her colleagues in the National Center for Research on Teacher Education. See Mary M. Kennedy, Deborah L. Ball, & G. Williamson McDiarmid, *A Study Package For Examining And Tracking Changes In Teachers' Knowledge* (National Center for Research on Teacher Learning, College of Education, Michigan State University, East Lansing, MI, 1993).

student achievement measures are often not well aligned with the curriculum and limited in how well they measure complex knowledge and understanding. Controlling for these variables poses considerable challenges to researchers.⁴³

Measures of teacher behavior are also flawed. Supervisors' ratings, which were used in one study, and teachers' self report, used in another study, are highly unreliable measures.⁴⁴ We included these studies, flawed as they are, because they are suggestive of the range of methodologies available to researchers interested in teachers' subject matter knowledge. Future research, we would hope, would aim to use more stable, sophisticated, and reliable measures.

Gaps

There remains much to discover about the subject matter preparation of teachers.

- ✓ We need to know more about how much subject matter knowledge, and of what type, prospective teachers need in order to ensure student learning.
- ✓ We need to know more about what course requirements are necessary to ensure the acquisition of that subject matter knowledge. In particular, we need to know more about the efficacy of combining subject matter learning with pedagogical preparation.
- ✓ We need to know more about the nature and quality of subject matter preparation, including the impact on teacher learning of various instructional methods in high quality, undergraduate and graduate discipline-based education.

Currently, there is little documentation and critique of teaching in higher education. This means that we know next to nothing about high-quality teaching in the subject matter courses that are part of the preparation of teachers. Several reports issued by the National Research Council suggest that there is concern for the quality of undergraduate teaching more generally in mathematics and the sciences. Specifically, there is concern about the steady diet of lecture-based teaching reported in many undergraduate mathematics and science classes.⁴⁵

- ✓ We need to know more about the content of subject-specific pedagogy classes across those institutions and about the instructional practices and curricula used in those courses.
- ✓ In addition to more research in mathematics and science, we need research on the subject matter preparation of teachers in other disciplines. Elementary teachers are responsible for teaching all subjects, and the nature of their subject matter preparation needs to be considered carefully. The subject matter preparation for teaching middle and high school English and history, as well as other subject areas, needs to be investigated with equal enthusiasm and rigor.
- ✓ Research about the nature and depth of subject matter preparation and its relationship to teaching practice needs to take into account differences in the subjects, including such things as student

⁴³ See, for example, the complex analyses of Goldhaber and Brewer, 2000; and Monk, 1994.

⁴⁴ Ferguson and Womack, 1993; Guyton and Farokhi, 1987.

⁴⁵ See, for example, *Moving Beyond Myths: Revitalizing Undergraduate Mathematics* (National Research Council, National Academy Press, Washington, DC, 1991); *Science Teaching Reconsidered: A Handbook* (National Research Council, National Academy Press, Washington, DC, 1997.); *Transforming Undergraduate Education in Science, Mathematics, Engineering, and Technology* (National Research Council, National Academy Press, Washington, DC, 1999).

characteristics as well as school and university contexts. In particular, research needs to attend to the differences in how directly academic disciplines connect with school subjects.

Question 2. What kinds of pedagogical preparation, and how much of it, do prospective teachers need? Are there differences by grade level and by subject area?

Findings

There is no research that directly assesses what teachers learn in their pedagogical preparation and then evaluates the relationship of that pedagogical knowledge to student learning or teacher behavior. Research on pedagogical preparation has remained at a high level of aggregation, giving little information about possible differences across grade level or subject area. At this level, results suggest some benefit of pedagogical preparation, but the measurements used make it difficult to see clear associations.

Conducting research about pedagogical preparation is complicated. One complication is that “pedagogical preparation” means many things. Prospective teachers take courses in instructional methods: sometimes those courses are subject-specific; sometimes they are generic. They also take courses in learning theories, educational measurement and testing, and in educational psychology, sociology, and history. Teacher education programs also offer courses in responding to diverse student populations, creating assessments, and managing classrooms. Furthermore, these courses are offered in different sequences across programs.

Compounding the problem is the fact that pedagogical preparation varies considerably across institutions. We found a number of studies in which researchers examined what prospective teachers learned in specific teacher education courses— instructional methods, for example, or educational psychology. Course content varies, as does sequencing, so that even when courses share the same title, they can be qualitatively different. This makes it nearly impossible to generalize across research studies that focus on a particular teacher preparation class.

For this report, then, we focused on research that explores the impact of pedagogical preparation across several components of a teacher preparation program. Our logic was that, even if individual courses might vary, there is more chance that *overall* teacher preparation programs might be somewhat comparable. We found two types of relevant research: research on certification and research on the value-added of education coursework.

Research Comparing Certified and Uncertified Teachers—One way to examine the overall effects of pedagogical preparation is to compare certified teachers with their uncertified colleagues. We found five studies that shed light on this contrast: three large scale studies, one study of 18 pairs of teachers who were matched on having students of the “same general ability,” and one interpretive study.⁴⁶ Sample sizes ranged from three to 36 to over 3,000.

- √ One study found that the students of certified mathematics teachers scored higher on standardized mathematics tests than those of uncertified teachers, and that certified teachers also scored higher on

⁴⁶ Darling-Hammond, 2000; Mark Felter, “High School Staff Characteristics and Mathematics Test Results” (*Education Policy Analysis Archives*, 1999, Volume 7, <http://epaa.asu.edu/epaa/v7n9.html>); Goldhaber and Brewer, 2000; Pamela L. Grossman, “Learning to Teach Without Teacher Education” (*Teachers College Record*, Volume 91, 1989, pp. 191-207); Hawk, Coble, and Swanson, 1985.

mathematics and teaching knowledge tests.⁴⁷ Likewise, another study found a negative correlation between percent of teachers with emergency certification and student mathematics achievement.⁴⁸ In another study, the researcher found a positive relationship between a state's percent of fully certified teachers and student achievement in mathematics and reading (two-thirds of the results were statistically significant; all of them were positive).⁴⁹ The same study found a negative relationship between student achievement and three indicators of a state's less-than-fully certified teachers: (a) percent of all less-than-fully certified teachers; (b) percent of new entrants to teaching who were uncertified (excluding transfers); and (c) percent of newly hired uncertified teachers. However, another study found no difference in the achievement of students who had teachers with certification versus those with temporary emergency credentials.⁵⁰

- √ One interpretive study found that secondary teachers with no pedagogical preparation were limited in their ability to engage high school students in the subject matter, and that those new teachers taught as they had been taught (in high school and college).⁵¹

A teaching credential is admittedly a crude indicator of professional study, and, unfortunately, these studies offer little insight into the specific aspects of pedagogical preparation that are critical.

The situation is complicated by variations across states in certification practices. Consider an analysis of the National Educational Longitudinal Study of 1988.⁵² Researchers found that certified mathematics teachers and teachers with temporary emergency certification have a positive impact on student test scores relative to teachers with either private school certification or who are not certified in mathematics.

What accounts for this? First, the sample size of emergency-certified teachers is quite small (in both mathematics and science), which makes the findings related to emergency certification less robust.⁵³ Second, 24 percent of the emergency-certified mathematics teachers and 32 percent of the emergency-certified science teachers held bachelor's degrees in education. Twenty nine percent of both groups had master's degrees in education, and most were experienced teachers with preparation in both pedagogy and subject matter.⁵⁴ This suggests that those teachers might have been traditionally prepared teachers working on temporary licenses while changing states or teaching fields.

Unfortunately, large-scale research that uses certification status and degrees as indicators for teacher preparation does not help us understand what aspects of subject matter and pedagogical preparation matter. This problem is exacerbated by the wide variation in certification practices across states. Research that uses complementary methods has potential for shedding light on this murky area. In the interpretive study,

⁴⁷ Hawk, Coble, and Swanson, 1985.

⁴⁸ Felter, 1999.

⁴⁹ Darling-Hammond, 2000.

⁵⁰ Goldhaber and Brewer, 2000.

⁵¹ Grossman, 1989.

⁵² Goldhaber and Brewer, 2000.

⁵³ This is a problem that the researchers themselves note when they caution readers about jumping to conclusions about certification based on their analysis.

⁵⁴ See Linda Darling-Hammond, Barnett Berry, and Amy Thoreson, "Does Teacher Certification Matter? Evaluating the Evidence" (*Educational Evaluation and Policy Analysis*, in press), as well as Dan D. Goldhaber and Dominic J. Brewer, "Evaluating the Evidence on Teacher Education: A Rejoinder," (*Educational Evaluation and Policy Analysis*, in press).

for example, the researcher found that secondary English teachers were unable to translate their knowledge of English into something that their students could understand and use. Future research will need better databases and more research (using complementary and sophisticated analytic tools) to help clarify these confusing results.

Research on the Value Added by Teacher Education Coursework—Another approach to understanding whether pedagogical preparation has an impact is to examine the value-added of education coursework in teacher preparation programs. We found one multiple regression, two correlational studies, and six interpretive studies.^{55,56} Sample sizes ranged from one to six teachers in case studies to over 1,000. Although the number of studies is limited, in general, the research suggests that there is a value added by teacher preparation. However, the research methods used and limited sample sizes in the interpretive research make it difficult to determine specifically what prospective teachers are learning in education coursework.

- √ In the two correlational studies, researchers contend that education coursework was a better predictor of teaching success than subject matter major or GPA prior to entering the teacher education program.⁵⁷ In the multiple regression, which we discussed in the context of Question 1, the researcher found that undergraduate mathematics education coursework contributed more to student gains than do courses in undergraduate mathematics coursework. A similar result, albeit weaker, was found between graduate science education coursework and student achievement in science.⁵⁸
- √ In the interpretive studies, researchers found that teachers attributed their knowledge of a range of instructional strategies, classroom discipline and management, and classroom routines to their education coursework.⁵⁹
- √ In three studies, researchers found that new teachers learned to reorganize their knowledge of the subject matter in their subject-specific education coursework.⁶⁰ In two other studies, researchers found, however, that the entering beliefs and knowledge of prospective teachers act as powerful predictors of what they learn in education courses.⁶¹

⁵⁵ We found many more studies that examined teacher learning within a particular course, but, given both the limited time frame for this report and the difficulties in comparing specific courses across institutions, we did not include those course-specific studies in this review.

⁵⁶ Paul E. Adams and Gerald H. Krockover, "Beginning Science Teacher Cognition and its Origins in the Preservice Science Teacher Program," (*Journal of Research in Science Teaching*, Volume 34, 1997, pp. 633-653); Ferguson and Womack, 1993; Julie Gess-Newsome and Norman G. Lederman, "Preservice Biology Teachers' Knowledge Structures as a Function of Professional Teacher Education: A Year-Long Assessment," (*Science Education*, Volume 77(1), 1993, pp. 25-45); Pamela L. Grossman and Anna E. Richert, "Unacknowledged Knowledge Growth: A Re-examination of the Effects of Teacher Education," (*Teaching and Teacher Education*, Volume 4, 1988, pp. 53-62); Pamela L. Grossman, Sheila Valencia, Kate Evans, Clarissa Thompson, Susan Martin, and Nancy Place, "Transitions into Teaching: Learning to Teach Writing in Teacher Education and Beyond," (*Journal of Literacy Research*, in press); Guyton and Farokhi, 1987; Sandra Hollingsworth, "Prior Beliefs and Cognitive Change in Learning to Teach," (*American Educational Research Journal*, Volume 26, 1989, pp. 160-189); Monk, 1994; Linda Valli with Andrew Agostinelli, "Teaching Before and After Professional Preparation: The Story of a High School Mathematics Teacher," (*Journal of Teacher Education*, Volume 44, 1993, pp. 107-118).

⁵⁷ Ferguson and Womack, 1993; Guyton and Farokhi, 1987.

⁵⁸ Monk, 1994.

⁵⁹ Adams and Krockover, 1997; Grossman and Richert, 1988; Grossman, et al., in press; Valli and Agostinelli, 1993.

⁶⁰ Gess-Newsome and Lederman, 1993; Grossman and Richert, 1988; and Grossman et al., in press. This finding may help explain the research results described in Question 1 concerning subject matter preparation.

⁶¹ Adams and Krockover, 1997; Hollingsworth, 1989.

Although the research is limited, it is nonetheless suggestive, for it appears that prospective teachers need to reorganize their subject matter knowledge into knowledge about how to teach subject matter to diverse students. Consider one interpretive study.⁶² In a yearlong study of prospective biology teachers, the teachers reported never having thought about the individual topics of biology or the interrelationships among those topics. That is, the teachers—all biology majors—could only list *courses* they had taken. They appeared to have little understanding of the field writ large. They knew little about how various ideas were connected to each other, nor could they readily explain the overall content and character of biology. Over the course of a year's worth of pedagogical preparation and field experiences, the new teachers began to reorganize their knowledge of biology according to how they thought it should be taught. While these results are limited, they resonate with other research on secondary English teachers where—in two separate studies—researchers found that education coursework provided new English teachers with a conceptual framework for teaching writing, a practice that is distinct from that of being a writer.⁶³

Together, these studies suggest the necessity of further research into the role that education coursework plays in assisting new teachers in applying their subject matter knowledge to the work of teaching. Furthermore, one study suggests that research on the impact of teacher preparation ought to include longitudinal investigations, for the researchers found that the impact of teacher preparation began to emerge in the second year of the new teachers' practice, rather than in the first year.⁶⁴

Weaknesses

Most research on teacher preparation is not funded by outside agencies. This typically has meant that the research is limited to a single institution where teacher education researchers can use the data generated by their local teacher education efforts; only two studies compared graduates of different programs. Thus, the sample populations of teachers who participated in the research are limited. It is difficult to know, for example, how representative of the larger population of newly prepared teachers are the graduates of such institutions as the University of New Hampshire or East Carolina University, or how the two groups might compare to one another.

Further, without knowledge of the "treatment," that is, what the pedagogical preparation entailed, it is impossible to replicate the research. For this reason, future research will need to tightly link rigorous qualitative work that documents the content of education coursework with rigorous and refined quantitative measures to track program impact.

⁶² Gess-Newsome and Lederman, 1993.

⁶³ Grossman and Richert, 1988; Grossman et al., in press.

⁶⁴ One longitudinal study found effects of teacher education by tracking prospective teachers from entry into teacher education until they completed their programs. The study, reported in Mary Kennedy's *Learning to Teach Writing: Does Teacher Education Make a Difference?* (New York: Teachers College Press, 1998), was a multi-investigator, longitudinal study of eight teacher education programs—a mix of college-based preservice, alternate route, and inservice. Kennedy reports on these programs' effects on prospective teachers' knowledge about writing and writing instruction. She characterized the programs according to their "substantive orientation." Looking at both the education coursework and subject matter courses in the programs, Kennedy characterized three programs as having a traditional, management orientation, with little intent to impart knowledge about writing or writing instruction. The other five had a reform orientation, attempting to help prospective teachers learn about what research on writing had concluded about the importance of learning writing strategies and linking writing to the author's purposes. Using questionnaires and interviews focused on specific aspects of writing instruction, Kennedy found that students in the reform-oriented programs tended to change their ideas about writing over the course of the program, learning to see writing and writing instruction as strategies to be used than prescriptions to be followed. She thus concluded that "the substance of teacher education makes a difference" (p. 21), while structural features like the number of required courses had little effect. For the case of writing instruction, this study gives some evidence that the overall program can have a measurable effect prior to independent practice.

The research on pedagogical preparation suffers from many of the same limitations that characterize the research on subject matter preparation. The indicators that are used for “education major” and “certification” are vague, unreliable, and sometimes inaccurate. Large-scale surveys do not have sufficiently sophisticated items to assess what teacher education graduates actually know or can do. Future research needs to include the development of more refined measures, for all research traditions.

Finally, because much of the in-depth research is done locally by teacher educators (who, as teacher educators, have an investment in the enterprise), results are sometimes suspect. This issue is a complicated one. On the one hand, researchers need to have knowledge of the phenomenon they are investigating. Teacher educators know a great deal about the content and character, challenges and complications of teacher education. On the other hand, critics have the right to raise questions about the obvious conflict of interest involved in teacher educators doing research that validates the need for teacher education. Future research can address these questions in multiple ways. First, teacher educator-researchers ought to aim for publishing in the most rigorously reviewed journals in education, as well as in journals outside of education related to their disciplinary perspectives (e.g., history, mathematics, economics, psychology, sociology, and the like). Second, research designs should include serious consideration of alternatives to traditional teacher education. We elaborate on these suggestions when we conclude this report with recommendations for future research.

Gaps

Future research on the pedagogical preparation of teachers should be designed to fill several major gaps in the literature:

- ✓ We need to know more about the actual knowledge and skill that new teachers acquire in their education coursework and associated experiences.
- ✓ We need systematic and comparative research on the content of pedagogical preparation (beyond lists of course titles) and on the instructional methods best suited for professional teacher preparation.^{65, 66}
- ✓ We need to know more about what teachers learn in subject matter education courses and how that professional knowledge compares to subject matter preparation of an academic major.
- ✓ We need to know more about the preparation of teachers to teach diverse student populations.

⁶⁵ We found several studies that described the content of particular teacher education courses and some in which researchers then also attempted to examine the connection between those courses and what new teachers learned. See, for example, Tom Bird, Linda M. Anderson, Barbara A. Sullivan, and Stephen A. Swidler, “Pedagogical Balancing Acts: Attempts to Influence Prospective Teachers’ Beliefs,” (*Teaching and Teacher Education*, Volume 9, 1993, pp. 253-267); Pamela L. Grossman, “Overcoming the Apprenticeship of Observation in Teacher Education Coursework,” (*Teaching and Teacher Education*, Volume 7, 1991, pp. 345-357); M. Wilson, 1994. Most of these studies, however, did not include thorough descriptions of the research methods used to collect and analyze the data used in the analyses.

⁶⁶ Promising new research also has been conducted, but the length of the reports (often including in-depth descriptions) excludes it from peer-reviewed journals. Consider, for example the three-volume series, Linda Darling-Hammond (Ed.), *Studies of Excellence in Teacher Education* (National Commission on Teaching and America’s Future, American Association for Colleges of Teacher Education, Washington, DC, 2000). While this research was not included in this review, it warrants attention by future researchers who are searching for models of how to accurately and systematically document, describe, and analyze the content and quality of pedagogical preparation.

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- √ We need to know more about the relative importance of particular components of pedagogical preparation. In particular, we need to know more about the relationship between components of pedagogical preparation and teacher effectiveness.

Question 3. What kinds, timing, and amount of clinical training (“student teaching”) best equip prospective teachers for classroom practice?

Findings

Research on clinical training in teacher preparation consists mainly of relatively small interpretive studies. They suggest that clinical experiences vary widely, but many focus on a relatively narrow range of teaching skills and are disconnected from other components of teacher preparation. Individual studies of clinical training provide ideas about how clinical experience might have more uniform positive effects.

Research on clinical training does not focus on the same kinds of outcomes that are studied in research on subject matter and pedagogical preparation. Rather than focusing on what prospective teachers learn, or how they apply their knowledge from subject matter and education coursework, research on clinical experiences has traditionally focused on attitude shifts.

Learning to teach typically involves spending considerable time in schools participating in field experiences of varying lengths, the staples of teacher preparation programs. Study after study shows that experienced and newly certified teachers alike see clinical experiences (including student teaching) as a powerful—sometimes the single most powerful—component of teacher preparation. Whether that power enhances the quality of teacher preparation, however, may depend on the specific characteristics of the field experience.

What constitutes “field experience” varies—both within and across institutions. Its intent is sometimes to show what the job of teaching is like, sometimes to develop skills in instruction and classroom management, sometimes to give practical reality to concepts encountered in university coursework. Some field experiences occur early on and are limited in their range and varied in direction, purpose, or structure. Other field experiences are connected to specific university courses. In recent years, there has been growing variation in the length of the final, culminating “student teaching” experience: with some new teachers having an eight-week stint in a classroom and others participating in full-year internships. Finally, the settings for clinical experience are sometimes haphazardly selected according to the number of “placements” needed for the current semester; more recently some universities have worked with school districts to create “professional development schools” in which teacher learning—both for prospective and practicing teachers—was an explicit and central mission of the school.

Here we present summaries of research on the problems associated with typical field experiences, on promising practices, on the factors that shape the quality of field experiences, and on the difference in impact between traditional (typically 8-12 week) student teaching experiences and the yearlong internship included in the five-year model of teacher preparation.

Problems Associated with Field Experiences—First, there is considerable agreement about the problems of typical field experiences. Many studies we found document what typically happens in student teaching experiences: Field experiences are often limited, disconnected from university coursework, and inconsistent. Because

this review was intended to focus only on what we know about high-quality teacher preparation, we did not exhaustively review the literature on what typically happens when field experiences are not carefully crafted and monitored.

The integration of experiences in the field with university coursework is complex work. Universities want to honor the knowledge of experienced teachers, yet there are often differences in views across schools and universities that are difficult to resolve. Further, teacher education programs—especially ones at large public institutions—must place hundreds of student teachers in schools. The need to find enough placements is sometimes in tension with maintaining standards for the quality of those placements.

We found 10 studies in the interpretive tradition, which, with one exception, involved sample sizes ranging from one teacher to between 10 and 18 teachers.⁶⁷ The exception was an interpretive study involving 93 student teachers in two different teacher education programs. The news about typical experiences is quite sobering.

- √ Several studies found that field experiences were often disconnected from other components of teacher preparation, and prospective teachers had difficulty applying what they had learned in those other components when they entered their practica.⁶⁸
- √ In one study, researchers found that student teachers' experiences in classrooms were limited in range, tending to focus on mechanical aspects of teaching and dominated by worksheets and workbooks.⁶⁹
- √ Some university programs do not coordinate student teaching experiences with the university coursework.⁷⁰ Other researchers have found that university courses and student teaching experiences can work together to maintain the status quo.⁷¹
- √ In one study, researchers found that when the student teachers become overwhelmed with the challenges of learning to teach, they revert to the norms of the schools in which they were taught, which sometimes means that they teach in ways quite different than those envisioned by university instructors.⁷²

In describing what prospective teachers actually learn through their clinical experiences, the research is scant. Several studies found that student teachers' entering beliefs about teaching, learning, and subject matter are difficult to change.⁷³

⁶⁷ Borko, Eisenhart, et al., 1992; Renee Clift, "Learning to Teach English-Maybe: A Study of Knowledge Development," (*Journal of Teacher Education*, Volume 42, 1991, pp. 357-372); Margaret Eisenhart, Hilda Borko, Robert Underhill, Catherine Brown, Doug Jones, and Patricia Agard, "Conceptual Knowledge Falls Through the Cracks: Complexities of Learning to Teach Mathematics for Understanding," (*Journal for Research in Mathematics*, Volume, (24), 1993, pp. 4-40); Margaret Eisenhart, L. Behm, and L. Romagnano, "Learning to Teach: Developing Expertise or Rite of Passage?," (*Journal of Education for Teaching*, Volume 17, 1991, pp. 51-71); Jesse Goodman, "What Students Learn From Early Field Experiences: A Case Study and Critical Analysis," (*Journal of Teacher Education*, Volume 38, 1985, pp. 42-48); Gary A. Griffin, "A Descriptive Study of Student Teaching (*Elementary School Journal*, Volume 89, 1989, pp. 343-364); Sandra Hollingsworth, 1989; Judith Shulman, "From Veteran Parent to Novice Teacher: A Case Study of Student Teacher," (*Teaching and Teacher Education*, Volume X, 1987, pp.); B. Robert Tabachnick, Thomas S. Popkewitz, and Kenneth M. Zeichner, "Teacher Education and the Professional Perspectives of Student Teachers," (*Interchange*, Volume 10(4), 1979-1980, pp. 12-29); and B. Robert Tabachnick and Kenneth M. Zeichner, "The Impact of Student Teaching Experience on the Development of Teachers' Perspectives," (*Journal of Teacher Education*, Volume 35, 1984, pp. 28-36).

⁶⁸ Borko, Eisenhart, et al., 1992; Clift, 1991; Eisenhart, Behm, and Romagnano, 1991; Goodman, 1985; Griffin, 1989; Hollingsworth, 1989; Shulman 1987.

⁶⁹ Tabachnick, Popkewitz, and Zeichner, 1979-1980.

⁷⁰ Eisenhart, Behm, and Romagnano, 1991; Griffin, 1989.

⁷¹ Tabachnick, Popkewitz, and Zeichner, 1979-1980.

⁷² Eisenhart, Behm, and Romagnano, 1991.

⁷³ Griffin, 1989; Tabachnick and Zeichner, 1984.

Promising Practices in Field Experiences—Yet there is hope. We found eight interpretive studies that suggest that field experiences and student teaching can be designed to be more educative. These studies involved sample sizes ranging from five to 15.⁷⁴ We also found two interpretive studies in which researchers compared different “treatments”—or kinds of clinical experiences. The samples in each of these studies were 26 and 37 preservice teachers.⁷⁵ Although the research base is limited, the studies suggest some potentially promising practices:

- ✓ In one study, when prospective elementary teachers were given an opportunity to observe and interview students learning to write during their field experiences, their conceptions of the teaching and learning of writing began to change.⁷⁶
- ✓ Another study demonstrated that a practicum designed to help preservice students learn to understand the caregivers of children caused beginning interns’ initial stereotypic view about poor, inner-city parents to change to the belief that parents and caregivers played a significant role in literacy while the school was partly to blame for retarding improvements.⁷⁷
- ✓ In a third study, researchers found that new teachers learned most from clinical experiences when they were required to do action research in the classroom.⁷⁸ Given the multiple interpretations of “action research,” it would be important to know more about the nature of these action research projects used in this research.
- ✓ In yet another study, researchers found that student teachers could learn as much (if not more) about how to reflect on teaching, organize instruction, and teach from laboratory experiences (as opposed to field experiences).⁷⁹
- ✓ Across several studies, one theme that emerges is that field experiences lead to more significant learning when activities are focused and well structured.⁸⁰
- ✓ Cooperating teachers have a powerful influence on the nature of the student teaching experience. In two studies based on the same research project, the researchers found that student teachers who were paired with cooperating teachers whose ideas and practices were somewhat

⁷⁴ Susan Florio Ruane and Timothy Lensmire, “Transforming Future Teachers’ Ideas about Writing Instruction,” (*Journal of Curriculum Studies*, Volume 22, 1990, pp. 277-289); Dana L. Grisham, Armando Laguardia, and Beverly Brink, “Partners in Professionalism: Creating a Quality Field Experience for Preservice Teachers,” (*Action in Teacher Education*, Volume 21(4), 2000, pp. 27-40); Grossman and Richert, 1988; Grossman, Valencia, et al., in press; Hollingsworth (1989); Althier M. Lazar, “Helping Preservice Teachers Inquire About Caregivers: A Critical Experience for Field-Based Courses,” (*Action in Teacher Education*, Volume 19(4), 1998, pp. 14-28); John L. Shefelbine and Sandra Hollingsworth, “The Instructional Decisions of Preservice Teachers During a Reading Practicum” (*Journal of Teacher Education*, Volume 38, 1987, pp. 36-42); Janell D. Wilson, “An Evaluation of the Field Experiences of the Innovative Model for the Preparation of Elementary Teachers for Science, Mathematics, and Technology” (*Journal of Teacher Education*, Volume 47, 1996, pp. 53-59).

⁷⁵ Kim K. Metcalf, M. A. Ronen Hammer, and Pamela A. Kahlich, “Alternatives to Field-Based Experiences: The Comparative Effects of On-Campus Laboratories” (*Teaching and Teacher Education*, Volume 12, 1996, pp. 271-283); Mark Y. Schelske and Stanley L. Deno, “The Effects of Content-Specific Seminars on Student Teachers’ Effectiveness,” (*Action in Teacher Education*, Volume 16, 1994, pp. 2-28).

⁷⁶ Florio Ruane and Lensmire, 1990.

⁷⁷ Lazar, 1998.

⁷⁸ Grossman et al., in press.

⁷⁹ Metcalf, Hammer, and Kahlich, 1996.

⁸⁰ Florio Ruane and Lensmire, 1990; Grisham, Laguardia, and Brink, 2000; Grossman et al., in press; Lazar, 1998; Metcalf, Hammer, and Kahlich, 1996; J. D. Wilson, 1996.

different than those of the student teacher learned more from their field experiences.⁸¹ However, other researchers have found that student teachers tend not to “rock the boat” in the classrooms in which they are placed for student teaching.⁸²

These studies share the limitations of the research on pedagogical preparation—for example, the research has investigated methods for guiding field experiences that are local, that is, often unique to a particular program at a particular institution. Generalization, at this stage, would be unwise. Nonetheless, such qualitative work does hold promise for informing future research.

The Factors that Shape What Happens in Student Teaching—Disentangling the impact of coursework, fieldwork, and other factors on learning to teach is complex, for it is inadequate to simply rely on participants’ self reports to determine where and what teachers learn. Furthermore, since prospective teachers are often simultaneously taking university courses and participating in clinical experiences, identifying the effects of separate program components is difficult. Finally, other factors significantly shape what new teachers learn in their field experiences. Across the research that we have already described, several critical factors emerged:⁸³

- √ Student teaching experiences are interpreted in varying ways by prospective teachers, even teachers in the same teacher education program. Student teachers’ beliefs and knowledge, as well as those of their cooperating teachers, play an important role in how they think about and learn from their field experiences.⁸⁴
- √ Cooperating teachers work with novice teachers in a wide variety of ways.⁸⁵ Some focus on subject matter and strategy, others assume that novice teachers know the subject matter they will teach, and others focus more on principles and maxims of teaching. Some cooperating teachers offer little by way of advice or support.⁸⁶ Some collaborating teachers interpret their job as one of socializing the student teacher into the status quo of the school⁸⁷ or into the practices of the cooperating teacher.⁸⁸ Sometimes cooperating teachers see their role as enabling innovation and independence on the part of the new teachers.⁸⁹
- √ In one study, the researcher found that general managerial routines have to be in place before prospective teachers can focus on teaching subject matter. Regardless of their subject matter preparation, prospective teachers who failed to routinize discipline, management, and instruction are often unable to focus on what students were learning.⁹⁰

⁸¹ Hollingsworth, 1989; Shefelbine and Hollingsworth, 1987.

⁸² Eisenhart, Borko, et al., 1993; Griffin, 1989; Tabachnick, Popkewitz, and Zeichner, 1979-1980.

⁸³ In addition to the studies already summarized, we found one additional study that informed this part of the analysis: Kathy Carter and Luz E. Gonzalez, “Beginning Teachers’ Knowledge of Classroom Events” (*Journal of Teacher Education*, Volume 44, 1993, pp. 223-232).

⁸⁴ Carter and Gonzalez, 1993; Griffin, 1989; Eisenhart, Borko, et al., 1993; Tabachnick and Zeichner, 1984; Hollingsworth, 1989; Shefelbine and Hollingsworth, 1987; Tabachnick and Zeichner, 1984;

⁸⁵ Eisenhart, Borko, et al., 1993; Grossman, Valencia, et al., in press; Hollingsworth, 1989; Shefelbine and Hollingsworth, 1987.

⁸⁶ J. Shulman, 1987.

⁸⁷ Goodman, 1985.

⁸⁸ Grossman, Valencia et al., in press.

⁸⁹ Grossman, Valencia, et al., in press; Grishman, Laguardia and Brink, 2000; Eisenhart, Borko, et al., 1993.

⁹⁰ Hollingsworth, 1989.

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- √ In one study, the researchers documented the myriad factors that shape a prospective teacher's field experiences, including: the teacher's subject matter knowledge, the openness of the cooperating teacher to certain kinds of instruction, as well the norms and expectations of the school and the school district.⁹¹

Consider one careful analysis that illuminates the complexities of understanding the relevant impact of field experiences. Researchers examined interview and observational data from prospective secondary teachers in two different university programs.⁹² When asked, prospective teachers cited fieldwork more than coursework as a source of knowledge. Yet when the researchers examined interviews and observational notes, they found significant, complementary influence of coursework. From field experience, the prospective teachers reported acquiring "survival skills," learning about students and their understanding, and recognizing that their students' understandings vary, are complex, and differ from the teachers'. Coursework, on the other hand, taught the prospective teachers about theoretical principles such as mainstreaming and grouping, as well as giving them "an image of the possible." Thus, in this study, both coursework and field experiences had an impact on the acquisition of professional knowledge, even though the program participants better recognized the value of the field experiences.

Comparisons of Five-Year and Four-Year Programs—One final area of research that sheds light on the question of appropriate field experiences concerns differences in the graduates of four- and five-year teacher preparation programs. We found two studies that examined this question, one large-scale study and one small interpretive study.⁹³

- √ In the large-scale study, the researcher found that teachers who went through a fifth-year program which included a yearlong internship (and took the same courses as their peers who went through a four year program with a shorter, more traditional student teaching experience) were more satisfied with teaching and with their teacher education program. They also had a higher retention rate and consistently rated their teaching abilities (e.g., planning instruction, conferencing with parents) higher.⁹⁴
- √ In one interpretive study of five elementary preservice teachers who did their student teaching in a professional development school, the researchers report that the year long experience was a significant factor that contributed to the quality of what the new teachers learned.⁹⁵

Weaknesses

The research on clinical experiences is weak in several ways. First, much of the early research on clinical experiences has focused on cooperating teachers' and prospective teachers' attitudes about field experiences. Although it is important to know how teachers feel about the benefits of field experiences, such attitude surveys do not answer

⁹¹ Eisenhart, Borko, et al., 1993.

⁹² Grossman and Richert, 1988.

⁹³ Michael D. Andrew, "Differences Between Graduates of 4-Year and 5-Year Teacher Preparation Programs" (*Journal of Teacher Education*, 1990, Volume 41, pp. 45-51); Grisham, Laguardia, and Brink, 2000.

⁹⁴ Andrew, 1990.

⁹⁵ Grisham, Laguardia, and Brink, 2000.

questions about what prospective teachers actually learn in those experiences. Future research should attempt to develop measures of what teachers actually learn through their field experiences.

Second, the measures that are used are relatively unreliable; self-report data in general are suspect. We need more measures of teacher learning, knowledge, and skill that do not rely on teachers' and administrators' self-reports or ratings.

Finally, the research done is interpretive and small scale. While this research sheds light on the factors that make field experiences complicated, the limited sample sizes and local "treatments" make it impossible to generalize from the research. Furthermore, the majority of this research is not published in the most competitive education journals; rather, the research typically appears in two teacher education-specific journals.⁹⁶ We need more rigorous research in this area that includes multiple methods, large scale and comparative designs, and is peer-reviewed by broader audiences.

Gaps

What we know about the typical clinical experience is sobering. The research demonstrates that traditional field experiences are often disconnected from coursework, focused on a narrow range of teaching skills, and reinforce the status quo. We also know that a number of more innovative programs have been developed, and that a few small-scale studies have shown positive effects of high-quality clinical experiences on knowledge of pedagogy, insights about children and community, and teachers' ability to reflect on and revise instruction. We now need more research in several domains.

- √ We need to know more about the impact of innovative field experiences (including collaborations like professional development schools) on new teachers' effectiveness.
- √ We need to know more about the relative impact of various types of field experiences: early field experiences, field experiences integrated into particular university courses, student teaching, and yearlong internships.
- √ We need to know more about the effects of varying lengths of clinical experiences, as well as practices and structures that enable teacher learning in those experiences.
- √ We need to know more about the relative contributions of coursework and fieldwork to a teacher's progress in learning to teach, more about the ways in which the coursework integrates into the fieldwork, and under what fieldwork conditions the novice teachers are most likely to continue to learn productively.
- √ We need large-scale studies to evaluate the effects of various innovations in clinical experiences.

⁹⁶ We are not suggesting that the *Journal of Teacher Education* and *Action in Teacher Education* do not publish high-quality research. However, we do believe that research on clinical experiences would be enhanced if researchers aimed to publish research on field experiences in a wider array of peer-reviewed journals.

Question 4. What policies and strategies have been used successfully by states, universities, school districts, and other organizations to improve and sustain the quality of pre-service teacher education?

Findings

There is almost no research that directly bears on this question. Several strategies, however, have captured the attention of policymakers: requiring program accreditation, strengthening state program approval, mandating additional coursework (especially on reading instruction), setting limits on the number of credits required in education coursework, increasing the amount of teacher testing and holding teacher education programs accountable for results of teacher testing, requiring a subject matter major, changing the duration of teacher preparation from four years to five, and establishing professional development schools. Other policies currently in use may have important implications for teacher preparation, among them changing teacher certification and creating or mandating induction programs. While enthusiasm for these policies is high, the research base is quite thin.

We searched for research on the effectiveness of policies, either describing the effects of policies on desirable characteristics of teacher preparation programs or describing the effects on students enrolled in those programs.⁹⁷ We found only four studies, two that used large samples to compare the certification test scores of teachers in different policy contexts,⁹⁸ one that compared characteristics of teachers from four-year and five-year programs,⁹⁹ and one that looked intensively at the effects of policy initiatives on a single program.¹⁰⁰

The two larger studies used scores from a set of tests widely administered for teacher certification as a measure of teacher quality. The researchers compared average certification test scores from different teacher preparation programs as a means to gauge the success of different policies. One study, for example, used data on 300,000 prospective teachers who took the teacher certification tests between 1994 and 1997.¹⁰¹ For most of those prospective teachers, the researchers also had college entrance examination (SAT or ACT) scores, so that they could take account of initial differences among students attending different programs. In a comparison of accredited and non-accredited teacher preparation programs, the researchers found that, in the accredited programs, a higher proportion of teacher certification test takers got scores high enough to meet state requirements. This difference cannot simply be explained by a difference in a program's ability to attract "better" students, since the college entrance scores were actually lower in the accredited programs.

⁹⁷ We note that our focus here was policy effects on teacher preparation programs and the students in those programs. Much of the policy research has looked instead at effects of policies on the characteristics of teachers employed in schools, asking, for example, about effects of policies on the proportion on teachers with full certification. Although the causes of changes in the teacher population might be due to changes in teacher preparation, they might also be due to changes in hiring practices. We did not include studies unless they explicitly looked at effects on preparation programs or the students in those programs.

⁹⁸ Drew H. Gitomer, and Andrew S. Latham, *The Academic Quality of Prospective Teachers: The Impact of Admissions and Licensure Testing* (Educational Testing Service, Princeton, N. J., 1999); Harold Wenglinsky. *Teaching the Teachers: Different Settings, Different Results* (Educational Testing Service, Princeton, N. J., 2000).

⁹⁹ Andrew, 1990.

¹⁰⁰ N. A. Prestine, "Political System Theory as an Explanatory Paradigm for Teacher Education Reform" (*American Educational Research Journal*, Volume 28, 1991, pp. 237-274).

¹⁰¹ Gitomer and Latham, 2000.

Overall, in these two large studies, researchers found that teachers did better on the certification tests if they attended institutions that:

- ✓ had been approved by the national accrediting association,¹⁰²
- ✓ had a low proportion of education majors / minors at the institution and a low proportion of the institutional budget devoted to education, or ¹⁰³
- ✓ had a relatively high proportion of traditional (i.e., full-time, under 25 years of age) students.¹⁰⁴

While these results suggest what might be learned from large-scale comparisons of teachers who graduated from programs with varying characteristics, more research is needed to have much confidence in these initial results and to ascertain the link between certification test scores and teaching practice.¹⁰⁵ Moreover, research is needed to make sense of the findings about the effects of the proportions of education majors / minors in the student body and of budget allocations in education. Does this association reflect differences not fully accounted for in entering student bodies? Does it represent institutional practices common in colleges with small teacher preparation programs, and capable of being adopted in colleges largely devoted to teacher preparation?

A policy currently under discussion involves changing teacher preparation programs from a four-year to a five-year design. The study that compared graduates of four-year and five-year programs at the University of New Hampshire is an example of research on field experience because the policy largely affects that teacher preparation component. There was a significant difference in retention and career satisfaction favoring five-year program graduates.¹⁰⁶ Generally five-year graduates showed increased interest in teaching and satisfaction with their teacher education coursework. The study suggests that different institutional policies about the structure of teacher education programs can lead to different characteristics of teachers. More

¹⁰² Gitomer and Latham, 2000.

¹⁰³ Wenglinsky, 2000.

¹⁰⁴ Wenglinsky, 2000.

¹⁰⁵ Two well-known books about teacher education devote some time to the policy effects question. Although these books were beyond the scope of our review, their prominence in recent discussions of teacher education is reason for a brief commentary. In the 1980s, John Goodlad and his team visited 19 teacher education institutions, gathering information through interviews, observations, and surveys. The results, published in *Teachers For Our Nation's Schools* (San Francisco, Jossey-Bass, 1990), describe the institutional contexts of teacher education, based on accounts from those engaged in it. The institutions visited were selected to represent the variety of programs in the U. S., in the sense that they included most of the major types of four-year institutions: public major research universities, public major comprehensive universities, private comprehensive universities, public and private regional institutions, and private liberal arts colleges. Because the study did not look at what prospective teachers learned in their programs, it offers no new research on the focal questions in our review. It did, however, use interviews with faculty and administrators to look at the effects of state policies and NCATE accreditation on their programs. Goodlad found that most people interviewed saw the state as an important regulatory force, with more resistance to change among the major universities than among the other institutions. In the eyes of the administrators and faculty, the changes made tended to be piecemeal, eroding, rather than enhancing, program quality. Participating in the NCATE accreditation process was seen to be of assistance in identifying serious problems but also seen as deflecting faculty energy from other planning, which Goodlad believes crucial to long-term improvement. Goodlad's conclusions are consistent with the conclusions of Prestine's Wisconsin case study but add the suggestion that the effects of state policies may vary across institutional types, and may push in the direction of piecemeal program change. They suggest a less positive impact of NCATE than the other study we found, perhaps because of the difference in evidence used (administrator and faculty interviews, versus scores on teacher examinations), or perhaps because the positive effect of identifying serious problems outweighs the negative effect on other planning efforts.

Another study on teacher education policy is reported in Michael Fullan, Gary Galluzzo, Patricia Morris, and Nancy Watson, *The Rise And Stall Of Teacher Education Reform* (American Association of Colleges for Teacher Education, 1998, Washington, D. C.). Michael Fullan and his colleagues conducted interviews to assess the effects of the Holmes Group, an organization of colleges of education that attempted to promote improvements in teacher preparation through changes in policy, creation of professional development schools, and changes in colleges of education. They conclude that the Holmes Group had an effect on the national debate about teacher education and, concretely, led to an increase in minority representation in schools and colleges of education. As with the Goodlad study, they rely on interviews with faculty and administrators, giving information on perceptions of policy effects, rather than on the effects themselves.

¹⁰⁶ Andrew, 1990.

research that examines these issues could guide institutions in program design. For example, are we correct in attributing most of the effect to changes in the field component or would similar effects come from using the extra year for subject matter study?

The other, single-program study described the University of Wisconsin-Madison School of Education's attempt to resist new program requirements developed by the Wisconsin Department of Education.¹⁰⁷ Drawing on interviews and analysis of meeting minutes, the investigator depicts the school of education's beliefs that it could maintain its autonomy, followed by its administrators' realization that the Wisconsin Department of Education did have the authority to dictate and enforce change. The report does not include an examination of subsequent changes in program courses, but it does present convincing evidence of the state government's ability to produce change, even in an institution with a well-defined and strong teacher education program. This finding runs against a belief sometimes expressed (and apparently held by the University of Wisconsin prior to this incident), that state policies were too weak to have any substantial effect on what goes on within higher education.

We found no other rigorously conducted studies that focused on the direct relationship between policies and the quality of teacher preparation. However, provocative evidence offered by one investigation suggests a direction for further investigations and offers one model for doing such research.¹⁰⁸ With evidence from national databases, this study demonstrated a statistically significant correlation between the percentage of colleges in a state that were NCATE accredited (a function of institutional and sometimes state policies on accreditation) and the percentage of teachers in the state who are well qualified (that is, have full certification and a major in their field). This research demonstrates the use of nationally representative data to examine policy effects but also illustrates the limitations of currently available national data on teacher preparation. The correlation indicates that some set of circumstances links the proportion of NCATE-accredited institutions to the proportion of well-qualified teachers. In the absence, however, of more detailed data about teacher preparation programs, the performance of their graduates, and the way preparation influences hiring and retention, research cannot show whether teacher quality is an effect of state policies about program approval, state mechanisms to facilitate hiring, widespread support for improving teacher quality, or some other set of factors. The association between program accreditation and patterns of teacher employment calls for further exploration. If national surveys began to collect more information about teacher preparation, large-scale research might help establish the link between state or institutional policies and teacher preparation variables.

Weaknesses

The major weakness of this research domain is the lack of literature. Given the heightened interest in using policies to enhance the quality of teacher preparation, there is much opportunity for significant comparative research that contrasts the impact of various policies currently being implemented.

Gaps

Research is needed on the effects of policy tools now being employed, as well as on other tools being considered. At present, there is little solid empirical research to support the adoption of policies intended to raise the quality of teacher preparation. The need is more urgent for research that looks at the conditions under which an array of policy levers helps improve teacher preparation. Those levers include:

¹⁰⁷ Prestine, 1991.

¹⁰⁸ Darling-Hammond, 2000.

- √ accountability programs,
- √ revised certification systems (e.g., multi-tiered, performance-based certification),
- √ collaborative partnerships between colleges and K-12 schools,
- √ college policies to encourage greater participation of arts and science faculty in collaboration with education faculty,
- √ school district incentives for teachers to give more attention to teacher preparation,
- √ state approval mechanisms, and
- √ national accreditation.

Future research needs to be designed to compare the relative impact of these levers, as well as different kinds of policies in each of these domains.

Question 5. What are the components and characteristics of high-quality alternative certification programs?

Findings

The research we reviewed indicates that alternative routes have been successful in recruiting a more diverse pool of teachers but have a mixed record in terms of the quality of teachers recruited and trained. Despite the heightened interest in alternative certification, research about its impact is limited and has produced decidedly mixed findings.¹⁰⁹ This may be in part because programs vary from one- or two-year preservice models (e.g., MAT programs) to programs offering a few weeks of training before placement as teacher of record.

We found 14 papers reporting on 11 studies that shed light on issues of alternative certification.¹¹⁰ One study was an in-depth analysis of one program;¹¹¹ three comparative studies involved the evaluation of the alternative routes in Dallas and Houston (sample sizes ranged from 69 to 110).¹¹² Three papers report various aspects of an analysis of a large-scale national survey of over 14,000 teachers.¹¹³ Four other

¹⁰⁹ The work of C. Emily Feistritzer at the National Center for Education Information provides helpful data on the prevalence of alternative routes. See, for example, C. Emily Feistritzer and David Chester, *Alternative Teacher Certification: A State-by-State Analysis 2000* (National Center for Education Information, Washington, DC, 2000).

¹¹⁰ Goldhaber and Brewer, 2000; Grossman, 1989; Guyton, Fox, and Sisk, 1991; W. Robert Houston, Faith Marshall, and Teddy McDavid, "Problems of Traditionally Prepared and Alternatively Certified First-Year Teachers," (*Education and Urban Society*, 1993, Volume 26, pp. 78-89); Jerry B. Hutton, Frank W. Lutz, and James L. Williamson, "Characteristics, Attitudes, and Performance of Alternative Certification Interns" (*Educational Research Quarterly*, 1990, Volume 14, pp. 38-48); James Jelmsberg, "College-Based Teacher Education Versus State-Sponsored Alternative Programs," (*Journal of Teacher Education*, Volume 47, 1996, pp. 60-66); Frank W. Lutz and Jerry B. Hutton, "Alternative Teacher Certification: Its Policy Implications for Classroom and Personnel Practice" (*Educational Evaluation and Policy Analysis*, 1989, Volume 11, pp. 237-154); McDiarmid and Wilson, 1991; John W. Miller, Michael C. McKenna, and Beverly A. McKenna, "A Comparison of Alternatively and Traditionally Prepared Teachers" (*Journal of Teacher Education*, 1998, Volume 49, pp. 165-176); Ruth A. Sandlin, Beverly L. Young, and Belinda D. Karge, "Regularly and Alternatively Credentialed Beginning Teachers: Comparison and Contrast of Their Development," (*Action in Teacher Education*, Volume 14, 1992-1993, pp. 16-23); Jianping Shen, "Has Alternative Certification Policy Materialized its Promise? A Comparison Between Traditionally and Alternatively Certified Teachers in Public Schools" (*Educational Evaluation and Policy Analysis*, 1997, Volume 19, pp. 276-283); Jianping Shen, "Alternative Certification, Minority Teachers, And Urban Education" (*Education and Urban Society*, Volume 31, 1998a, pp. 30-41); Jianping Shen, "The Impact of Alternative Certification On The Elementary And Secondary Public Teaching Force," (*Journal of Research and Development in Education*, Volume 31(1), 1998b, pp. 9-16); Trish Stoddart, "Los Angeles Unified School District Intern Program: Recruiting and Preparing Teachers for an Urban Context" (*Peabody Journal of Education*, 1990, Volume 67, pp. 84-122).

¹¹¹ Stoddart, 1990.

¹¹² Hutton, Lutz, and Williamson, 1990; Houston, Marshall, and McDavid, 1993.

¹¹³ Shen, 1997, 1998a, 1998b.

studies compared graduates of alternate routes to traditionally prepared first-year teachers in New Hampshire,¹¹⁴ Georgia,¹¹⁵ and California.¹¹⁶ One interpretive study involved in-depth case studies of three new teachers who had no prior preparation;¹¹⁷ another study compared alternate route teachers' knowledge and beliefs with a national sample of graduates from teacher preparation programs.¹¹⁸

The research supports several important results:

- √ *Alternative routes are attracting a more diverse pool of prospective teachers in terms of age and ethnicity.*¹¹⁹
- √ *Alternative routes have a mixed record for attracting the "best and brightest."* In one analysis involving a national sample of over 14,000 teachers, 3.3 percent of the alternatively certified teachers did not have BAs. In that same analysis, the researcher found that more alternatively certified teachers were teaching out of field in mathematics and science.¹²⁰ In a case study of Los Angeles Unified School District, however, prospective teachers in alternate routes had grade point averages that met or surpassed national averages of traditionally certified teachers (however, the study also found that alternatively certified teachers' GPAs were lower than traditional recruits in mathematics and science).¹²¹

In two reports based on the same database, researchers contrasted the knowledge of alternatively certified interns with that of a national sample of teacher candidates from programs across the U.S. The researchers found that the secondary and elementary teachers suffered from the same weak mathematical knowledge described in Question 1 concerning traditional teacher candidates.¹²² An analysis of English teachers suggested that traditionally prepared English teachers were significantly more knowledgeable about specific instructional strategies for teaching writing.¹²³ This result resonates with another study, in which the researcher found that three English teachers who had no teacher preparation prior to teaching had no formal understanding of how to represent the subject matter to their students and fell back on instructional strategies that had worked for them as students in high school or college. These strategies were largely idiosyncratic and ill suited for the students.¹²⁴

- √ *There are higher percentages of alternatively certified teachers teaching in urban settings or teaching minority children.* In two studies, researchers found that high percentages of alternatively certified teachers were teaching in urban settings or in schools where the majority of the

¹¹⁴ Jelmberg, 1996.

¹¹⁵ Miller, McKenna, and McKenna, 1998.

¹¹⁶ Sandlin, Young, and Karge, 1992.

¹¹⁷ Grossman, 1989.

¹¹⁸ McDiarmid and Wilson, 1991.

¹¹⁹ Guyton, Fox, and Sisk, 1991; Houston, Marshall, and McDavid, 1993; Hutton, Lutz, and Williamson, 1990; Lutz and Hutton, 1989; Stoddart, 1990. The three articles by Shen (all based on the same data analysis) also support this claim.

¹²⁰ Shen, 1997, 1998a.

¹²¹ Stoddart, 1990.

¹²² McDiarmid and Wilson, 1991.

¹²³ Stoddart, 1990.

¹²⁴ Grossman, 1989.

students were from minority populations.¹²⁵ In their evaluation of the Dallas alternative route, however, researchers found no significant difference in the SES of the schools in which alternatively certified and traditionally prepared teachers taught.¹²⁶ While it is heartening that alternate routes might be fulfilling their promise of placing more teachers in high need and urban settings, the fact that two studies showed that higher percentages of those teachers were teaching out of subject is worrisome.¹²⁷ This raises the possibility that poorly conceptualized or administered alternative routes may simply exacerbate inequities in schooling that already exist. One study did find that alternatively certified interns in one city held high expectations for low-income and minority students and attempted to develop curriculum and instruction responding to the needs of diverse learners.¹²⁸

- √ *Evaluations of the performance of alternate route and traditionally prepared teachers produce mixed results.* In two studies of the same alternative route, researchers found that—when rated by their mentors—the alternatively certified teachers got high evaluations on their performance as teachers; they also had higher mean passing scores on the statewide certification test.¹²⁹ However, principals rated a comparison group of traditionally prepared first year teachers higher than alternately certified interns on reading, discipline, management, planning, and instructional techniques. The alternatively certified teachers, we should note, had gone through an extensive program with high entry standards. Of the 691 applicants who took basic skills exams, only 110 interns were admitted to the program after an evaluation of an entrance essay and a structured interview. They also participated in professional coursework, planned and taught practice lessons, and were closely supervised and mentored. Only 59 were eventually certified after their first year in the program; others dropped out or were categorized as “pending” until their files were complete or their performance improved.

In another study, the researcher found the opposite: Principals rated teachers from the college-based teacher education programs as being better prepared in teaching methods and educational foundations than the alternatively certified teachers. The teachers themselves concurred.¹³⁰ In two other studies, no difference was found in teaching behaviors or difficulties encountered by the new teachers.¹³¹

We found one study that examined the effects of alternative program status on student achievement.¹³² This study of a university-based alternate route featuring extensive coursework and intensive

¹²⁵ Houston, Marshall, and McDavid, 1993; Shen, 1997, 1998a, 1998b.

¹²⁶ Hutton, Lutz, and Williamson, 1990; Lutz and Hutton, 1989.

¹²⁷ Houston, Marshall, and McDavid, 1993; Shen, 1997, 1998a, 1998b.

¹²⁸ Stoddart, 1990.

¹²⁹ Hutton, Lutz, and Williamson, 1990; Lutz and Hutton, 1989.

¹³⁰ Jelmberg, 1996.

¹³¹ Guyton, Fox, and Sisk, 1991; Miller, McKenna, and McKenna, 1998.

¹³² Miller, McKenna, and McKenna, 1998.

supervision and mentoring found no differences in the average student achievement of matched pairs of alternatively and traditionally certified teachers on their students' performance on the Iowa Test of Basic Skills.

- √ *Teachers who have come through high-quality alternative routes and teachers traditionally certified show some similarities.* On some dimensions, traditionally and alternatively prepared teachers are similar. Several studies found no significant difference when comparing alternative route teachers and traditionally certified teachers on a number of characteristics. For instance, alternatively certified and traditionally certified teachers tend to be more alike than different in terms of socioeconomic status and gender.¹³³ In several studies, especially after the induction year, observers rated alternatively and traditionally certified teachers similarly in terms of their performance, particularly when alternatively certified teachers came from structured alternate routes.¹³⁴ And, in two studies alternatively certified and traditionally certified teachers' attitude profiles concerning self-efficacy and confidence were similar.¹³⁵ However, in others, alternate route teachers were less confident about their knowledge and practice.¹³⁶
- √ *Successful alternate routes appear to be resource- and labor-intensive. Many programs have high drop-out rates.* In her study of the Los Angeles Unified School District's alternative route, one researcher reported that, of the 1,100 recruited alternatively certified teachers in a six-year time frame, 29 percent had left the district (and may have left teaching) in that same time frame.¹³⁷ In the Dallas program, 11 of 110 interns dropped out within the first year, while another 24 were recommended to be placed in a "pending" category due to deficiencies in their preparation or materials. The minority alternatively certified teachers in another study indicated they did not plan on staying in teaching.¹³⁸ In another study, traditionally prepared teachers were found to be more positive about staying in the profession, and five of 23 alternatively certified teachers had dropped out of the program before the end of the year.¹³⁹ On the other hand, in one study the researchers found no differences in alternatively certified and traditionally certified teachers, after eight months of teaching, in terms of their job satisfaction or their intentions to be teaching in the next five years.¹⁴⁰

These contradictory findings seem puzzling. Clearly, alternative certification varies across contexts.¹⁴¹ To begin with, some states treat all post-baccalaureate programs as "alternate", whether they include preservice coursework and student teaching or offer little structured traing. Moreover, some alternate routes have high

¹³³ Guyton, Fox, and Sisk, 1991; Lutz and Hutton, 1989; Shen, 1997.

¹³⁴ Lutz and Hutton, 1989; Miller, McKenna, and McKenna, 1998; Sandlin, Young, and Karge, 1992.

¹³⁵ Guyton, Fox, and Sisk, 1991; Miller, McKenna, and McKenna, 1998.

¹³⁶ Jelmberg, 1996; Lutz and Hutton, 1989.

¹³⁷ Stoddart, 1990.

¹³⁸ Shen, 1997, 1998a, 1998b.

¹³⁹ Guyton, Fox, and Sisk, 1991.

¹⁴⁰ Houston, Marshall, and McDavid, 1993.

¹⁴¹ See, for example, Karen Zumwalt, "Alternate Routes to Teaching: Three Alternative Approaches" (*Journal of Teacher Education*, Volume 42(2), 1991, pp. 83-92).

standards for entry, and some require substantial coursework and mentoring. In fact, in some contexts, alternative certification may be more similar to traditional certification than different. For example, the Dallas Independent School District Alternative Route Program was initially the product of a collaboration between the school district and East Texas State University. In this instance, the alternatively certified interns might have gotten more support in the form of supervision and mentoring than the typical teacher education student. However, their coursework and study might otherwise have been very similar to traditional teacher education. The number of credit hours required for courses in Los Angeles Unified School District's alternate route is comparable to that required in California teacher preparation programs, and analyses of transcripts suggest that the content of those courses is similar to college-based teacher preparation.¹⁴² That is, alternative certification programs in some of these studies, while they might be packaged differently or be offered on a different timeline, might have key aspects in common with traditional teacher education programs. Yet all do not. For example, in one study of a district alternative route, the researcher found that attendance was the sole criterion for passing all program requirements. Teacher candidates were not held accountable for learning any of the material offered by the school district in its carefully designed curriculum.¹⁴³

We found one extensive description of the content and character of an alternative route that met the criteria for this review.¹⁴⁴ Since the research literature seldom includes descriptions of the content and components of these alternative routes, it is difficult to determine whether the variation in the research results is due to differences in program quality. Given the literature that does exist, however, it appears that several features may be important to high quality alternative certification, including:¹⁴⁵

- √ high entrance standards,
- √ extensive mentoring and supervision,
- √ extensive pedagogical training in instruction, management, curriculum, and working with diverse students,
- √ frequent and substantial evaluation,
- √ practice in lesson planning and teaching prior to taking on full responsibility as a teacher, and
- √ high exit standards.

Weaknesses

The research in this domain suffers from weaknesses similar to those we have already noted, including a reliance on supervisors' ratings, problematic proxies for subject matter knowledge, and the like. We will not reiterate them here. An additional weakness that arises in research on alternate routes concerns a problem with the data that three studies are based upon. As one critic suggests, teachers' responses were inaccurate. Specifically, teachers might have been confused about their certification.¹⁴⁶ For example, 52 percent of the teachers who reported that they completed an alternative

¹⁴² Hutton, Lutz and Williamson, 1990; Lutz and Hutton, 1989; Stoddart, 1990.

¹⁴³ Stoddart, 1990.

¹⁴⁴ Stoddart, 1990.

¹⁴⁵ Hutton, Lutz, and Williamson, 1990; Lutz and Hutton, 1989.

¹⁴⁶ Dale Ballou, "Alternative Certification: A Comment" (*Educational Evaluation and Policy Analysis*, Volume 20, 1998, pp. 313-315). See also, the response of Jianping Shen, "Alternative Certification: A Complicated Research Topic," (*Educational Evaluation and Policy Analysis*, Volume 20, 1998, pp. 316-319).

certification program also said that their undergraduate major was in education. This confusing finding might be due to the fact that some traditionally prepared teachers go through alternate routes when they apply for licensure in another state; it might also be due to the fact that teachers were confused about their certification. Whatever the source of the confusion, these concerns reiterate an earlier point we made: Future research must include more sophisticated and accurate databases.

Furthermore, much of the early research on alternative routes was conducted when those programs were first being created. Because the programs themselves were under development, the “treatments” involved in those programs were relatively unstable, changing as the programs changed. Now that more states have programs, and many of the programs are more established, it is time for new research.

Gaps

There are significant gaps in the research on alternative certification. Specifically, we need to design lines of investigation that:¹⁴⁷

- ✓ Describe the content and components of high-quality alternative certification programs.
- ✓ Document and analyze the professional knowledge (both of subject matter and of teaching) that graduates of alternate routes acquire, and how they acquire it, and relate that knowledge to teaching practice.
- ✓ Compare matched pairs of traditionally prepared and alternatively certified teachers to shed light on the impact of high-quality alternative routes into teaching versus traditional preparation. Longitudinal designs would be useful in this area.
- ✓ Examine the effects of components of alternate routes (mentorship programs; university- or school district-based coursework; admissions standards, including grade point averages, and the like, on teaching practice.
- ✓ Strengthen the objectivity of studies of alternatively and traditionally certified teachers. Currently, the biases of the researchers (pro or con alternative routes) are often reflected in their analyses.

RECOMMENDATIONS FOR FUTURE RESEARCH ON TEACHER PREPARATION

Although limited, the existing research on teacher preparation suggests that there is important research to be done. Furthermore, research summarized here, as well as research—in the form of books, meta-analyses, conference presentations, and research reports—that was not included in this review, has the potential for serving as an important foundation for the next generation of teacher preparation research.

Our recommendations take three forms. First, we list a set of research design principles to ensure that future research offers well-grounded findings. Second, we recommend domains of further inquiry where research seems likely to produce

¹⁴⁷ See Willis D. Hawley, “The Theory and Practice of Alternative Certification: Implications for the Improvement of Teaching” (*Peabody Journal of Education*, Volume 67, pp. 3-34, 1990.)

trustworthy results to important questions of policy and practice. Third, we make suggestions about investment opportunities that might be strategic in furthering our knowledge.

Research Design Principles

The findings we have discussed suggest what might be learned, but some characteristics of the studies limit their ability to give a strong foundation for policy and practice. To ease interpretation and accumulation of findings, we recommend seven considerations in the design and conduct of future research.

- √ *Data collected about teacher preparation should describe specific features of the content and quality not merely counts of courses and vague terms such as “alternate route.” We need better analytic and descriptive tools for characterizing teacher preparation programs and their policies, as well as more refined and stable measures of teacher knowledge and teacher behavior.*

Simplistic and vague variables obstructed our interpretation of results in the studies we identified. The value of alternate routes, for example, was difficult to assess because the label was applied to too wide an array of programs. The meaning of differences between regularly certified and emergency-credentialed teachers was uncertain because some emergency-credentialed teachers had degrees in education, while others had no education background. Apparent contradictions about the value of lengthy subject matter preparation might be explained by differences in what is meant by a subject matter “major” or by variations in course quality.

Research would be improved by basing studies on features of teacher preparation that are less ambiguous and more likely to be related to what teachers actually learn. Some ways of describing program content and quality do exist and can be more widely used. For example, the frameworks and survey tools used to describe mathematics and science content in the Third International Study of Science and Mathematics might be adapted for these purposes. But it will also be necessary to map the domain by studying teacher preparation curriculum materials and practices at a variety of institutions. To avoid constraining research to current practice, some comparison to forward-looking views of what teachers need to know will also be needed. Whenever possible, researchers should use similar instruments to facilitate comparisons across settings.

- √ *Programs of research must include or facilitate comparisons among plausible alternatives.*

As we noted, research around each focal question is limited because it describes what prospective teachers have learned in a particular course or program but does not address the question of how their learning would have been different under other circumstances. Since the policy or program decision is usually a choice between different ways of preparing teachers, not a choice of whether to prepare them or not, comparative work is necessary and possible.

Some comparisons might examine teacher preparation components or programs already in use. Design of these comparisons could build on prior studies of multiple programs, making modifications to strengthen them where needed. The Teacher Education and Learning to Teach study,¹⁴⁸ for example, which was the basis for some studies included in this review,¹⁴⁹ described the features of several teacher preparation programs and tracked what students in the programs learned. While this study was

¹⁴⁸ Described in Kennedy, 1998.

¹⁴⁹ For example, Ball, 1990a, b; McDiarmid & Wilson, 1991; and Stoddart, 1990.

intended to describe a broad range of program types, further research should compare the effects of teacher preparation that uses competing approaches with roughly comparable student bodies. The recent studies published by the American Association of Colleges of Teacher Education¹⁵⁰ should also be reviewed to see what inferences their designs support and how those designs might be extended in new research.

Other comparisons could set up “design experiments” by creating new program elements, perhaps using promising practices described in interpretive studies of single programs or instructors, and then carry out disciplined inquiry on those new program elements. For example, given prospective elementary teachers’ inadequate subject matter knowledge for mathematics teaching, university faculty in mathematics and mathematics education might collaboratively design new rigorous subject matter courses meant to prepare new teachers. Simultaneously, researchers could investigate the impact of those courses on teachers’ knowledge and behavior, looking for changes likely to improve student achievement.

√ *Research that seeks general conclusions across programs must inform research that looks closely at particular contexts, and vice versa.*

Studies that use national samples have yielded findings that give information about teacher preparation across the country, but sometimes these studies use such general questions that the results are hard to interpret. Among studies of policies, for example, we cite one that showed a negative connection between teachers’ test performance and the proportion of institutional expenditures on teacher preparation.¹⁵¹ The finding is of interest because it describes a generalization across many institutions, but the connection between institutional variables and the quality of teacher preparation is unclear. Without additional questions about how funds are spent, such a study gives little guidance to an institution that wishes to improve its teacher preparation. In-depth studies of how a few institutions allocate resources to teacher preparation would be a promising basis for designing additional questions, which could then be used in further broad surveys.

Studies of the local effects of particular courses and programs provide ideas about ways to give teachers important knowledge and skills but leave questions about how similar approaches would work in other contexts. The value of these studies could be enhanced if their collection of information included variables found in important broad-scale studies.

What is needed, then, is interplay between studies that have samples chosen to support broad generalization and studies that take a close look at particular cases. The case material can help in identifying promising variables to be included in broad surveys. The surveys can aid in locating and interpreting results in particular cases.

√ *Design and reporting of research on teacher preparation must be explicit about connections to improving student achievement.*

Research on teacher preparation, like other education research, should contribute to our understanding of how to improve student achievement. Most teacher preparation research makes a contribution by identifying the features of teacher preparation that improve the quality of those being prepared. To help practitioners and policymakers see the contributions of the research, reports should make the connections to student achievement explicit, using measures of teacher knowledge, skill, and practice that are thought important for effective teaching. Because the effects of teacher preparation on student achievement are distant in time and complicated by other intervening events, it is seldom practical to gather student

¹⁵⁰ Darling-Hammond, 2000b, 2000c, and 2000d.

¹⁵¹ Wenglinsky, 2000.

achievement data as part of teacher preparation research. But improving student achievement remains the ultimate goal. From the design of studies to the interpretation and reporting of results, that connection should be obvious.

- √ *Research should include explicit attention to teacher outcomes that are particularly important for teaching in urban and poor rural settings.*

Very little research has paid careful attention to the question of preparing teachers to teach in urban and poor rural areas. The extant research on alternative certification suggests that a more diverse teaching force is appearing in those schools, but it is troubling to find that less qualified teachers (for example, out-of-field teachers or, in the case of one analysis, teachers without a BA) are also teaching in those schools. We need to know much more about how to prepare teachers for those schools and how to create policies that ensure that those children get highly qualified teachers. In the best of all possible worlds, research would include design features that shed light on the challenges of preparing teachers to teach diverse student populations, including those in urban and poor rural settings.

- √ *We need research designs and analytic methods that control or test for other important variables.*

Research that attempts to examine the relationships between student achievement and teacher preparation must be designed for and sensitive to the factors that make that relationship tenuous at best. For example, if less prepared teachers are more likely to be in low-performing schools, we do not know whether the school's performance is due to the teachers' lack of preparation or whether the low performance of the school made it difficult to attract well-prepared teachers. Or the effects of a particular aspect of teacher preparation may depend on characteristics of the teacher preparation students, including those students' ideas about what they need to learn.¹⁵² Researchers are developing data analytic techniques and models that can be used to control for many variables. Future research should strive to conceptualize and use designs that enable more refined analyses, as well as more complex and rigorous analytic techniques.

- √ *Research on teacher preparation ought to include longitudinal studies of teacher learning and systemically examine the continuum of teacher learning experiences from initial preparation to induction to professional development.*

Although this review focused on initial teacher preparation, contemporary wisdom suggests that learning to teach is best considered as a continuum. Learning to teach begins with one's undergraduate coursework (in academic disciplines and education), extends into formal teacher preparation and then into induction programs designed to support new teachers as they enter the profession, and, finally, is linked to high quality professional development opportunities. Assessing the impact of teacher preparation programs ought to include designs that examine impact longitudinally. Further, some future research ought to link research on teacher preparation with teacher induction with professional development.

¹⁵² Older students who have already raised large families, for example, may benefit relatively little from courses on classroom management because they already feel competent in handling children.

Domains of Future Research in Teacher Preparation

Building on the existing base of rigorous research, new research programs need to be pursued in the following domains:

Domain 1: The subject matter preparation of teachers. Here, we especially need research that attends to the content and quality of that preparation and to the differences across subject areas and grade levels.

Research has shown that subject matter preparation is important and that the current results of subject matter preparation are disappointing. Inconsistencies in specific results need to be resolved through further study, which must give greater attention to the nature of content and quality. What constitutes quality probably varies by subject area, and we know more about some subject areas than others. The one study that contrasted mathematics and science teacher preparation reminds us that curricular areas are quite different. Both social studies and science are curricular domains that include multiple disciplines. Research is needed that is designed to tease out similarities and differences in the subject matter preparation of beginning teachers and its effects on teachers' practice, knowledge, and skills. Similarly, for teachers who will be responsible for multiple subjects (as in the elementary grades), we need to know much more about what constitutes adequate subject matter preparation. Such work could be done in collaboration with subject matter experts in the disciplines.

Domain 2: The contribution of particular components of teacher education, by themselves or in interaction with one another, to prospective teachers' knowledge and competence. Exploring the relative contributions of education method and education foundation courses on prospective teachers is especially important.

Methods and foundations courses are the perennial targets of criticism, though the criticisms have as little solid empirical basis as the defenses of such program components. Some of the debate around alternate routes—vaguely defined as they are—may be seen as differences of opinion about the value of education coursework. Research is needed both to describe the variety of experiences that go under these rubrics and to understand their effects on prospective teachers, alongside and in interaction with other components such as clinical experience and subject matter preparation. Further research in this vein might benefit from longitudinal designs that can assess how what is learned in methods or foundations courses figures into teachers' development over the long term.

Domain 3: The design and organization of clinical experience, and its relation to the larger set of connections between K-12 schools and teacher preparation programs.

K-12 teachers have always played a major role in teacher preparation field experiences. A major rationale for creation of professional development schools has been improved sites for field experience of prospective teachers. Research is needed to look at the range of ways schools and colleges collaborate in the context of teacher education, through PDSs or other means, with special attention to how these collaborations affect field experiences or other aspects of teacher preparation.

Domain 4: The design, implementation, and relative payoff of different forms of alternate routes.

The research to date on alternative routes has taken us only part way toward understanding the potential of the many kinds of "alternative" preparation for teaching. The proliferation of such programs at the present time offers a natural

“laboratory” for rigorous comparative research, following the design principles outlined above. Such research can help to establish clearly which forms of alternative route preparation offer a high-quality learning experience for prospective teachers.

Domain 5: The effects of policies designed to influence teacher preparation. We need a better understanding of how teacher education institutions interpret and respond to these policies, and the resulting effect on program components and what prospective teachers learn in them.

State and national policymakers are becoming more prescriptive about what should go on in teacher preparation and how teacher preparation programs should be held accountable. Research is needed to see what effects these policies are having on the quality of teacher preparation and what factors influence the ways in which the policies are implemented. Policies originating at different levels (federal, state, institution) need to be studied to understand how they interact with one another and cumulatively influence what is going on in teacher preparation.

Investment Opportunities

To move forward in answering the key questions about teacher preparation, researchers and those who fund research should think strategically about where to invest available resources, both human and financial. Based on our review, we suggest the following principles for strategic investments in research on teacher preparation.

- ✓ *Take advantage of current teacher educator-researcher interest in self-study by supporting multi-site research initiatives on particular promising program components.*

We found many small studies of local teacher education practice. Currently, these studies offer ideas but are not easily aggregated to support general conclusions about the effects of teacher preparation practices. If the effort put into these local studies could be organized around a shared focus, with a common framework for collection of information about program, context, and outcomes, the results of many local studies could be analyzed to give a clearer understanding of how programs might be improved. Funding agencies could promote such coordinated local studies by offering support for a research team to organize the studies, carry out analyses, and provide some funding to support data collection at individual program sites. This strategy would be a way to channel some of the current enthusiasm teacher educators have for self-study into work that will shed much needed light on the nature and content of high quality teacher preparation.¹⁵³

- ✓ *Build on other research and policy initiatives to make substantial, sustained investments on focused areas of teacher preparation.*

Literacy, mathematics, and science education are areas of great current national interest. The National Science Foundation has funded large Collaboratives for Excellence in Teacher Preparation, as well as projects to improve science and mathematics teaching and curriculum throughout higher education. Several states have mandated coursework on reading instruction, even though the report of the National Reading Panel found less than a handful of studies on the effectiveness of teacher education approaches for the teaching of reading.

¹⁵³ “Self Study of Teacher Education Practices” is one of the largest special interest groups in the American Educational Research Association.

That interest in teaching reading, mathematics, and science might provide support for interagency funding of research on teacher preparation, focused on subject matter and pedagogical preparation for those subject areas. This is a current trend in research funding, and one that is particularly appropriate for future teacher preparation research.

- √ *Help build capacity in the research community to enable a few large-scale studies to provide a broader and more detailed picture of current teacher preparation practices.*

Most of the studies we reviewed were small and local. The work that used survey data often had to make do with surveys designed for other purposes, which included little detail on the content and structure of teacher preparation. Having more detailed national data would greatly increase the potential of studies that attempt to connect features of teacher preparation with outcome data such as scores on teacher examinations. Researchers need help in recognizing that resources are available for such work.

- √ *Encourage and invest in studies that will build understanding of the conditions under which teacher education accountability can lead to the greatest increases in teacher quality.*

The recent changes in the Higher Education Act have called on teacher preparation institutions to be more accountable for the performance of their graduates. The revised system of national accreditation has a similar focus on outcomes. These changes reflect acute national interest in accountability and provide both an opportunity to study the responses of teacher preparation institutions and the effects on entrance into teaching, as well as retention. The state-to-state variations in teacher education policy could be treated as a set of natural experiments, and studying them could shed light on the sets of conditions under which accountability mechanisms lead to increasing program quality and content, rather than simply creating superficial compliance.

As we mentioned at the start, there is no shortage of opinions about what it takes to prepare a high-quality teaching workforce. This review of the literature, however, suggests that the research upon which those opinions are based is limited. However, the studies that do exist—across multiple research traditions—are heartening, for they demonstrate that rigorous research on teacher preparation is possible. In fact, the potential of research to lead the ongoing reform and improvement of teacher education in the United States is enormous. By building on what we know and by conducting rigorous studies of important questions, the research community can do its part to ensure that a well-qualified teacher is available for every child, in every classroom.

APPENDIX A

Elaboration of Criteria for Rigorous Research

As noted in the text of our report, with the advice of our Technical Working Group, we developed guidelines for selecting the reports of research to include in this summary. We included only studies with findings pertinent to the five study questions that were empirical, rigorous, published within the past two decades, and in the United States.

In our decision about whether a study was rigorous, we divided studies according to their general methodology and developed criteria for each type:¹⁵⁴

- ✓ For experimental and quasi-experimental studies, they must have used random assignment to group or some form of matching for entering characteristics.
- ✓ For multiple regression studies, the studies would have to have “controlled” for relevant differences among students, other than the teacher education they received.
- ✓ For follow-up surveys, we only included studies that sent surveys to a representative sample of alumni and had a return rate of at least 60 percent. For these studies, we restricted inferences to alumni perceptions, not allowing inferences about the effects of programs on other beliefs and knowledge.
- ✓ For comparisons of credentialed and non-credentialed teachers, we treated them like multiple regression studies, only including studies that controlled for relevant differences among the two groups, other than the characteristic of being credentialed.
- ✓ For longitudinal studies of change, we only included studies that checked for effects of attrition. We also limited attention to studies that offered evidence that the changes were not simply due to maturation and teaching experience.
- ✓ For “interpretive” studies, we limited our attention to reports that included a description of their processes for data collection and analysis and that included evidence, such as samples of interview responses or detailed descriptions of events, as part of the report.¹⁵⁵

¹⁵⁴ Our categories build on those described by Kennedy, 1999.

¹⁵⁵ By “interpretive” studies, we mean those that try to understand educational experiences from the perspectives of those involved, usually by some mixture of in-depth interview and relatively unstructured observation. An informative treatment of the methods for such studies is Frederick Erickson, “Qualitative Methods in Research on Teaching” (in *Handbook of Research on Teaching*, 3rd. ed., edited by Merle C. Wittrock, pp. 119-61. New York: Macmillan, 1986).

APPENDIX B

Question 1, Part 1: Research on Subject Matter Preparation

Study	Research Tradition Sample Size Variables	Findings
<p>Darling-Hammond (2000) Teacher Quality And Student Achievement: A Review Of State Policy Evidence. <i>Education Policy Analysis Archives</i></p>	<p>Survey and comparative population study (multiple regression and partial correlations) 1993-94 School and Staffing Survey (SASS) 65,000 teachers Data on NCATE certification collected from 50 states State average NAEP scores in mathematics: grade 4 in 1990, 1996; grade 8 1992, 1996 State average NAEP scores in reading: grade 4 in 1992, 1994 State is unit of analysis.</p>	<p>A state's average NAEP scores in reading and mathematics was positively associated with the state's percentage of well-qualified teachers (full certification and major in their field). A state's average NAEP scores in reading and mathematics was negatively associated with the state's percentage of teachers out of field (less than a minor in the field they teach). A state's average NAEP scores in reading and mathematics was positively associated with the state's percentage of fully certified teachers. A state's average NAEP scores in reading and mathematics was negatively associated with three indicators of the state's percentage of less than fully certified teachers: % of all teachers less than fully certified, % of new entrants to teaching who are uncertified (excluding transfers), % of all newly hired teachers uncertified. The percentage of teachers with both a major and full certification in their field was positively correlated with the percentage of teacher education institutions in a state that are NCATE accredited.</p>
<p>Ferguson and Womack (1993) The Impact of Subject Matter and Education Coursework on Teaching Performance <i>Journal of Teacher Education</i></p>	<p>Survey and comparative population study (ANOVA and stepwise regression) 266 secondary student teachers at Arkansas Tech University. Grades from seven education courses, GPA in the major, NTE Specialty scores, and ratings from both subject matter specialists and education supervisors on a Likert scale observation instrument for teaching performance</p>	<p>Education coursework accounted for 48% of the variance in teaching performance when teaching performance was rated by education supervisors and 39% when performance was rated by subject matter supervisors. Subject matter major and NTE explained a considerably lower proportion of the variance (1% and 9% respectively) for the outcome variable as rated by subject matter specialists and by education supervisors. <i>Note: The models do not include comparable detail about performance in subject matter courses.</i></p>

<p>Goldhaber and Brewer (2000) Does Teacher Certification Matter? High School Teacher Certification Status and Student Achievement <i>Educational Evaluation and Policy Analysis</i></p>	<p>Survey and comparative population study (multiple regression) National Educational Longitudinal Survey 1988 3,786 students in mathematics 2,524 students in science 2,098 mathematics teachers 1,371 science teachers 10th and 12th grade standardized test scores in mathematics and science is the outcome variable. Independent variables are grouped into: <ul style="list-style-type: none"> • individual and family background characteristics of students • schooling resources, which include school, teacher, and class specific variables. Teacher variables include type of certification (standard subject, probatory subject, private school, none), degree level, and experience.</p>	<p>Students with teachers who hold standard certification or private school certification in their subject have 12th grade math tests with scores between 7 to 10 points higher than students of teachers with probationary or emergency certification, or who are not certified. Similar results were found for student achievement on a 10th grade mathematics test. The results were similar for science, but are less pronounced. Students from lower SES backgrounds tend to get teachers who have emergency or probationary credentials, or no certification. Thus, students are not randomly distributed across teachers by type of certification. Students who do poorly in 10th grade are more likely to be assigned to a teacher who does not have standard certification in mathematics in 12th grade. Students with teachers who had degrees in mathematics were found to have higher test scores relative to those with teachers with out-of-subject degrees. In science, there was no effect. Math students with teachers with bachelor's or master's degrees in mathematics have higher test scores relative to those with out-of-subject degrees. There is no significant relationship between teacher subject matter major and student achievement in science. Having a degree in education had no impact on student science scores, but a BA in education had a negative impact on mathematics achievement. Students of teachers who have standard certification or emergency certification have higher math scores than students whose teachers have private school certification or no certification. The effects are not as strong in science, but follow the same trends.</p>
<p>Guyton and Farokhi (1987) Relationships Among Academic Performance, Basic Skills, Subject Matter Knowledge, and Teaching Skills of Teacher Education Graduates <i>Journal of Teacher Education</i></p>	<p>Correlational research Graduates from Georgia State University between 1981 and 1984 Sample ranged from 151 to 411, depending on availability of data. 413 teachers with statewide Teacher Certification Test scores (subject matter knowledge) 273 with Teacher Performance</p>	<p>GPA was significantly correlated with teaching success as measured on the Teacher Performance Assessment inventory, a measure of on-the-job performance used with beginning teachers in Georgia. Both sophomore and upper level GPAs also correlated significantly with Teacher Certification Test scores, as did subject matter knowledge as measured by the Regents Tests of basic skills. Basic skill ability is correlated with subject matter knowledge but not related to on-the-job performance. GPA at sophomore year and upon graduation were both positively correlated with teaching performance,</p>

<p>Hawk, Coble and Swanson (1985) <i>Certification: It Does Matter</i> <i>Journal of Teacher Education</i></p>	<p>Assessment Inventory scores GPA (sophomore and upper level) Georgia Regents Test scores (basic skills)</p>	<p>although the correlation was stronger upon graduation. The grades in education courses that contribute to GPA at graduation (and, although not noted by the authors, possibly grades in upper level courses in subject matter) were a stronger predictor of success on-the-job than grades in general knowledge courses as measured in sophomore GPA.</p> <p>The Teacher Certification (subject matter) test was not correlated with teacher performance as measured on the Georgia Teacher Performance Assessment Instrument, suggesting that one cannot simply do well as a teacher with only subject matter knowledge.</p> <p><i>Note: Additional information about GSU program requirements would be necessary to fully interpret the differences in relationship between sophomore and upper level GPAs and the measures of teaching performance.</i></p>
	<p>Comparative/quasi-experimental study (ANOVA, t-tests) Graduates of East Carolina University 36 mathematics teachers of grades 6–12 were followed in the study. All were certified. 18 teachers were in-field and 18 were teaching out-of-field. 826 students Teachers matched on school, teaching the same mathematics course, to students of same ability Students tests: Stanford Achievement Test (general math) and Stanford Test of Academic Skills (algebra) Tests of arithmetic and elementary algebra were administered to teachers. Teaching performance was measured by the CTPAS.</p>	<p>Significant differences were apparent from the post-test in general mathematics and algebra. Students who had in-field teachers scored higher.</p> <p>In-field teachers scored significantly higher on the CTPAS and the knowledge test. Chi-square analysis yielded no significant differences due to years of teaching or degree held by teachers in the study.</p>

Monk (1994)

Subject Area Preparation of Secondary Mathematics and Science Teachers and Student Achievement

Economics of Education Review

Survey research and comparative population study (multiple regression)

Longitudinal Study of American Youth

51 randomly selected school sites; base sample of 2,829 students; selected localities nationwide

608 mathematics teachers, 483 science teachers

Sampling rubric included geographic local and community type (rural, suburban, urban).

Teacher survey about number of undergraduate and graduate courses in various curricular areas

Student achievement measured by selected NAEP items (1,492 students) at both 10th and 11th grades

Found positive relationships between the number of undergraduate mathematics subject matter courses in a teacher's background and improvement in students' mathematics performance, for both sophomores and juniors.

For sophomores, teacher course-taking at the graduate level in mathematics also has a positive effect on student achievement.

After five mathematics courses, the addition of courses in mathematics has a smaller effect on pupil performance.

Mathematics education courses: Undergraduate coursework is positively related to improvement in mathematics for sophomores and juniors. Graduate mathematics education courses have a modest positive effect at the junior level. Courses in undergraduate mathematics pedagogy contribute more to student performance gains than do undergraduate mathematics courses.

Having mathematics major has no apparent bearing in pupil performance.

Teachers' degree level has quite a different effect compared to course-taking variables; there is either a zero or negative relationship between additional training and student performance.

The number of mathematics courses in a teacher's background has a positive effect on students in advanced courses and a zero effect on students in remedial courses.

Teacher undergraduate preparation in the life sciences has no discernible impact on student performance.

Positive relationships were found between undergraduate coursework in physical sciences and gains in pupil performance, for both sophomores and juniors.

There was a positive relationship between junior gains in achievement and graduate coursework in life sciences.

Graduate courses in science pedagogy were positively related to student achievement for sophomores. Undergraduate coursework in science pedagogy had a positive relationship with student achievement for juniors. The magnitudes of the relationships in science between course taking and student gains were quite small.

Having a science major was positively related to student gains for juniors.

Advanced teacher training was either not related or negatively related to student achievement for science and mathematics for sophomores.

The interaction between undergraduate course-taking in the physical

<p>Rowan, Chiang, and Miller (1997) Using Research on Employee's Performance to Study the Effects of Teachers on Students' Achievement <i>Sociology of Education</i></p>	<p>Correlational research (correlation, regression, hierarchical linear modeling) National Education Longitudinal Study of 1988 (NELS:88) 5,381 students in 410 schools Variables for students: NELS 10th grade math test, course taking and track, other background Variables for teachers: score on NELS math quiz, major in mathematics, emphasis on teaching for higher order thinking, motivation Other school variables</p>	<p>sciences and the subject taught is statistically significant both for sophomores and juniors, with the physical sciences sign being positive for pupil's performance in the life sciences.</p>	<p>Students who were taught by teachers who had majored in mathematics had higher levels of achievement in mathematics. The effect size was quite small (.015SD).</p>
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Question 1, Part 2: Research on the Typical Subject Matter Knowledge of Beginning Teachers

Study	Research Tradition Sample Size Variables	Findings
<p>Adams (1998) Prospective Elementary Teachers' Mathematics Subject Matter Knowledge: The Real Number System <i>Journal for Research in Mathematics Education</i></p>	<p>Interpretive and survey research 93 prospective elementary teachers in elementary methods course in large southeastern university Self-reported background Open ended mathematics assessments</p>	<p>Despite having taken multiple college mathematics classes, prospective elementary teachers have limited understanding of the real number system.</p>
<p>Ball (1990) Prospective Elementary and Secondary Teachers' Understanding of Division <i>Journal for Research in Mathematics Education</i></p>	<p>Interpretive study 10 elementary and 9 secondary prospective teachers about to enroll in first education course Elementary prospective teachers majoring in elementary education; secondary students mathematics majors or minors Data from student academic records and interviews about division in various contexts</p>	<p>All but two of the prospective teachers could calculate answers to division by fraction problems correctly, but both the elementary and the secondary majors had significant difficulty with the meaning of division by fractions. Only five could explain the meaning of division by zero. In a question about algebraic equations, 14 of the students, including all of the mathematics majors, focused on the mechanics of manipulating the equation. In general, most of the prospective teachers—whether they majored in mathematics or not—had fragmented and rule-bound mathematical understanding.</p>
<p>Ball (1990) The Mathematical Understandings that Prospective Teachers Bring to Teacher Education <i>Elementary School Journal</i></p>	<p>Survey, interpretive, and longitudinal study 252 preservice teachers at 5 institutions (217 elementary, 35 math majors intending to teach high school), from the Teacher Education and Learning to Teach Study (TELT) Questionnaires with all interviews with a sub sample</p>	<p>Elementary and secondary (mathematics majors) prospective teachers had difficulty explaining and articulating their knowledge of division of fractions. Only 30% of elementary and 40% of secondary selected an appropriate representation of a division by fractions problem. Over 30% of the secondary prospective teachers reported that most mathematics cannot be explained. Most elementary and prospective secondary teachers believed that mathematics concerned memorization and understanding standard procedures; few of them thought that mathematics had conceptual dimensions.</p>

<p>Borko, Eisenhart, Brown, Underhill, Jones, and Agard (1992) Learning to Teach Hard Mathematics: Do Novice Teachers Give Up Too Easily? <i>Journal for Research in Mathematics Education</i></p>	<p>Interpretive study Case of one middle school mathematics student teacher in the larger database of 8 teachers who participated in the Learning to Teach Mathematics Study Observations, interviews, observations of university courses</p>	<p>The teacher believed that good mathematics teaching included making mathematics relevant and meaningful. The researchers could not get the teacher to speak about the division of fractions in a meaningful way at the beginning of her student teaching year, and there was little evidence that she had a conceptual understanding of division by fractions. Although her knowledge of fractions seemed to deepen some throughout her participation in a mathematics methods course, she still could not provide a coherent explanation concerning the division of fractions, even after her student teaching experience. During her student teaching, she was unable to realize her image of good mathematics teaching because her own knowledge of the division of fractions and of how to represent the idea to students in instruction was limited. The teacher education program worked to reinforce the teacher's limited understanding of mathematics and mathematics teaching, rather than questioning it or helping the teacher reinvent her understanding of division of fractions. The university program did not create the conditions for the teacher to overcome the limitations of her own knowledge.</p>
<p>Graeber, Tiros, and Glover (1989) Preservice Teachers' Misconceptions in Solving Verbal Problems in Multiplication and Division <i>Journal for Research in Mathematics Education</i></p>	<p>Interpretive study 129 college students enrolled in mathematics subject matter or methods courses for early education majors at a large university in southeastern U. S. Interviews with a sub sample and a subject matter knowledge test (26 items) was taken by all participants.</p>	<p>Of the preservice teachers, 39% answered 4 or more of the 13 multiplication and division problems incorrectly. All interviewees held various misconceptions about multiplication and division. Preservice teachers demonstrated the weak understanding of multiplication and division. Their knowledge resembled the knowledge of 10- to 15-year-olds in other research on division and multiplication.</p>
<p>McDiarmid and Wilson (1991) An Exploration of the Subject Matter Knowledge of Alternate Route Teachers: Can We Assume They Know Their Subject? <i>Journal of Teacher Education</i></p>	<p>Interpretive and survey study N=55 Undergraduate degrees in mathematics, 8 in the intensive sample, all in two alternate routes Another 8 intensive sample interviewees who majored in something else but were to be elementary school teachers Questionnaire and interviews</p>	<p>In general, prospective teachers did well on rules of thumb in mathematics but could not explain how those rules worked or represent problems accurately.</p>

<p>Simon (1993) Prospective Elementary Teachers' Knowledge of Division <i>Journal for Research in Mathematics Education</i></p>	<p>Interpretive study Large eastern teacher education program in large public state university 33 prospective elementary school teachers for subject matter knowledge test (five open response problems) 8 teachers were then interviewed as they worked on problems from the original test.</p>	<p>Prospective teachers demonstrated serious shortcomings in their understanding of division as a model for situations. The teachers had appropriate knowledge of symbols and algorithms associated with division. But their conceptual knowledge was weak, and they knew little of appropriate connections between different ideas in division.</p>
<p>Stoddart, Connell, Stofflett, and Peck (1993) Reconstructing Elementary Teachers Candidates' Understanding of Mathematics and Science Content <i>Teachers and Teacher Education</i></p>	<p>Two parallel interpretive studies, one with elementary prospective mathematics teachers, one with elementary prospective science teachers Medium size university in the western U.S. 83 prospective elementary mathematics teachers 49 prospective elementary science teachers Paper and pencil subject matter tests administered on entry to the elementary education methods classes</p>	<p>Future teachers had limited understanding of the mathematics subject matter they would have to teach. The majority could answer simple computational problems. Only half could correctly solve story problems or problems that involved the multiplication, division, and equivalency of fractions. Results show that the majority of teacher candidates entered the course with a poor understanding of science content. Between 60% and 90% of the participants held naïve or scientifically naive views of weather phenomena (condensation, temperature, precipitation, etc.). The prospective teachers' knowledge of these phenomena resembled that of the elementary school children they were to teach.</p>
<p>Tirosh and Graeber (1989) Preservice Elementary Teachers' Explicit Beliefs about Multiplication and Division <i>Educational Studies in Mathematics</i></p>	<p>Interpretive study 135 undergraduate teacher education students enrolled in mathematics subject matter or methods courses at a large university Mathematics test of beliefs about multiplication and division and computational skills Half were also interviewed about conceptions of multiplication and division.</p>	<p>85% responded correctly to the statement "In a multiplication problem, the product is greater than either factor." (Correct answer is FALSE.) 90% responded correctly to a statement that could be checked immediately by performing a computation. Only 45% responded correctly to "In division problems, the quotient must be less than the dividend." (Correct answer is FALSE.) Performance rates on computation tests were generally good. Preservice teachers have misconceptions about multiplication and division.</p>

<p>Wilson (1994) One Preservice Secondary Teacher's Understanding of Function: The Impact of a Course Integrating Mathematical Content and Pedagogy <i>Journal for Research in Mathematics Education</i></p>	<p>Interpretive study Case study of one student intending to become a secondary school mathematics teacher. At the time of the study, she was participating in a secondary mathematics pedagogy course in a university. Written mathematical tasks about functions and seven interviews about functions, technology, and other topics.</p>	<p>The subject sees textbooks as major sources for authority in mathematics, believes it is sufficient for students to only know how to correctly apply procedures, and that it is the teacher's responsibility to teach correct rules and procedures in an organized fashion. She understands functions as computational activities and believed that graphs of functions should be continuous. Over the period of the course, her understanding of functions improved.</p>
<p>Wilson and Wineburg (1989) Peering at History through Different Lenses <i>Teachers College Record</i></p>	<p>Interpretive study 4 prospective high school social studies teachers Interviews and observations over one year</p>	<p>Only one of the three teachers had an accurate understanding of history as a subject matter.</p>

Question 2: Research on Pedagogical Preparation

Study	Research Tradition Sample Size Variables	Findings
<p>Adams and Krockover (1997) Beginning Science Teacher Cognition and Its Origins in the Preservice Secondary Science Teacher Program</p> <p><i>Journal of Research in Science Teaching</i></p>	<p>Interpretive study</p> <p>4 beginning secondary science teachers who went through a teacher preparation program at a large midwestern university</p> <p>2 science teacher education instructors at the same university</p> <p>Interviews, observations (45 hrs), videotapes of classroom interaction, and document analysis</p> <p>Interview instrument: Teachers' Pedagogical Philosophy Interview</p> <p>Cases developed with coding and memos; cross case analysis</p> <p><i>Note: Data analysis process is described in detail.</i></p>	<p>The teachers attributed their knowledge of student-centered instruction, general pedagogical knowledge (including classroom discipline and classroom routines), and pedagogical content knowledge (including instructional strategies) to the teacher education program.</p> <p>All of the teachers viewed the teacher education program and particular courses in it as the source of their knowledge of classroom discipline. Two of the four teachers also attributed their knowledge of general class management as being based on courses within the program, while the other two felt they learned about this on the job.</p> <p>Knowledge about instructional strategies came from teacher education courses, undergraduate teaching assistantships, subject matter courses, and other teaching experiences.</p> <p>Though three of the students did not credit their methods course with providing curricular knowledge, there was evidence of its influence in their practice.</p> <p>For three of the teachers, knowledge about student-centered learning came from their methods course.</p> <p>There was considerable variation in what the teachers learned from the teacher preparation courses. Factors that contributed to this variation included the schools in which they were teaching and differences in their prior experiences.</p> <p>Courses in teacher education provided the beginning teachers with a framework with which to organize, understand, and reflect on their experiences in classrooms.</p>
<p>Darling-Hammond (2000) Teacher Quality And Student Achievement: A Review Of State Policy Evidence.</p> <p><i>Education Policy Analysis Archives</i></p>	<p>Survey and comparative population study (multiple regression and partial correlations)</p> <p>1993-94 School and Staffing Survey (SASS)</p> <p>65,000 teachers</p> <p>Data on NCATE certification collected from 50 states</p>	<p>A state's average of NAEP scores in reading and mathematics was positively associated with the state's percentage of well-qualified teachers (full certification and major in their field).</p> <p>A state's average of NAEP scores in reading and mathematics was negatively associated with the state's percentage of teachers out of field (less than a minor in the field they teach).</p> <p>A state's average of NAEP scores in reading and mathematics was positively associated with the state's percentage of fully certified teachers.</p>

	<p>State average NAEP scores in mathematics: grade 4 in 1990, 1996; grade 8 1992, 1996 State average NAEP scores in reading: grade 4 in 1992, 1994</p> <p>State is unit of analysis.</p>	<p>A state's average of NAEP scores in reading and mathematics was negatively associated with three indicators of the state's percentage of less than fully certified teachers: % of all teachers less than fully certified, % of new entrants to teaching who are uncertified (excluding transfers), % of all newly hired teachers uncertified.</p> <p>The percentage of teachers with both a major and full certification in their field was positively correlated with the percentage of teacher education institutions in a state that are NCATE accredited.</p>
<p>Fetler (1999) High School Staff Characteristics and Mathematics Test Results <i>Education Policy Analysis Archives</i></p>	<p>Correlational research (multiple regression) 795 regular California high schools (the sample did not include CA alternative high schools) These schools report employing 56,571 FTE. School average Stanford 9 test scores from 1998 in mathematics. Professional Assignment Information Form, conducted as part of the CA Basic Educational Data System (demographics, assignments, and positions/credentials)</p>	<p>10.5% of mathematics teachers in these high schools have emergency permits; a majority of these possessed only a baccalaureate degree. About one fourth of credentialed mathematics teachers had completed work beyond the M.A. Student poverty has the strongest relationship with test scores. Teaching experience and student participation are positively related to test results. Student participation and percent of mathematics teachers with emergency permits predict test scores equally well. Negative correlation between the percent of teachers with emergency permits and student achievement.</p>
<p>Ferguson and Womack (1993) The Impact of Subject Matter and Education Coursework on Teaching Performance <i>Journal of Teacher Education</i></p>	<p>Survey and comparative population study (ANOVA and stepwise regression) 266 secondary student teachers at Arkansas Tech University. Grades from seven education courses, GPA in the major, NTE Specialty scores, and ratings from both subject matter specialists and education supervisors on a Likert scale observation instrument for teaching performance.</p>	<p>Education coursework accounted for 48% of the variance in teaching performance. Subject matter major and NTE explained less than 1% of the variance.</p>

<p>Gess-Newsome and Lederman (1993) Preservice Biology Teachers' Knowledge Structures as a Function of Professional Teacher Education: A Year-Long Assessment <i>Science Education</i></p>	<p>Interpretive study 10 preservice secondary biology teachers enrolled in science education course Questionnaire (3 times in one semester) and one 30 minute interview with each participant Cross-case analysis provided</p>	<p>Preservice teachers reported that they had never thought about the constituent topics of biology or the interrelationships among those topics. In general the prospective teachers generated lists of topics they had studied in college biology courses and provided few connections among them. They had isolated memories of lists of topics and no coherent picture of the subject matter as a whole. The prospective teachers' subject matter conceptions were unstable over their teacher preparation. New topics were added, and teachers appeared to try and create more interconnections. They acquired this knowledge in subject specific teacher education courses. During student teaching, the teachers began to organize their subject matter knowledge according to how they thought it should be taught. Their teaching experiences influenced the organization of their knowledge of biology.</p>
<p>Goldhaber and Brewer (2000) Does Teacher Certification Matter? High School Teacher Certification Status and Student Achievement <i>Educational Evaluation and Policy Analysis</i></p>	<p>Survey and comparative population study (multiple regression) National Educational Longitudinal Survey 1988 3,786 students in mathematics 2,524 students in science 2,098 mathematics teachers 1,371 science teachers 10th and 12th grade standardized test scores in mathematics and science is the outcome variable. Independent variables are grouped into: 1. Individual and family background characteristics of students 2. Schooling resources, which include school, teacher, and class specific variables. Teacher variables include type of certification (standard subject, probationary subject, private school, none), degree level, and experience.</p>	<p>Students with teachers who hold standard certification or private school certification in their subject have 12th grade math tests with scores between 7 to 10 points higher than students of teachers with probationary or emergency certification, or who are not certified. Similar results were found for student achievement on a 10th grade mathematics test. The results were similar for science but are less pronounced. Students from lower SES backgrounds tend to get teachers who have emergency or probationary credentials, or no certification. Thus, students are not randomly distributed across teachers by type of certification. Students who do poorly in 10th grade are more likely to be assigned to a teacher who does not have standard certification in the relevant subject matter in 12th grade (in mathematics). Students with teachers who had degrees in mathematics were found to have higher test scores relative to those with teachers with out-of-subject degrees. In science, there was no effect. Math students with teachers with bachelor's or master's degrees in mathematics have higher test scores relative to those with out-of-subject degrees. There is no significant relationship between teacher subject matter major and student achievement in science. Having a degree in education had no impact on student science scores, but a BA in education had a negative impact on mathematics achievement.</p>

<p>Grossman (1989) Learning to Teach Without Teacher Education <i>Teachers College Record</i></p>	<p>Interpretive study Interviews and observations Longitudinal study as part of the Knowledge Growth in a Profession Project 3 new secondary English teachers who did not have teacher education who were teaching in the Bay Area in California</p>	<p>Students of teachers who have standard certification or emergency certification have higher math scores than students whose teachers have private school certification or no certification. The effects are not as strong in science but follow the same trends.</p> <p>The AC teachers found it hard to reconceptualize English as a school subject and to rethink it so as to make it accessible to their students.</p> <p>The AC teachers also found it difficult to anticipate student knowledge and potential difficulties.</p> <p>The AC teachers explained away teaching difficulties with lack of student motivation and unwillingness to work hard.</p> <p>The AC teachers used teaching strategies that they had experienced as learners. Sometimes these were college models and inappropriate for their high school students.</p> <p>The AC teachers shared a "conception of teaching that presupposes bright, motivated students who are eager to learn from a knowledgeable teacher" (p. 200).</p> <p>For the AC teachers, planning meant subject matter preparation (reading the book or the play), not thinking through how students would best learn it.</p>
<p>Grossman and Richert (1988) Unacknowledged Knowledge Growth: A Re-examination of the Effects of Teacher Education <i>Teaching and Teacher Education</i></p>	<p>Interpretive study Two-year study of beginning teachers as part of the Knowledge Growth in a Profession Project in the Bay Area in California. Secondary analysis of interview and observational data Interviews and observations during teacher preparation and first year of teaching 6 preservice secondary teachers (English, mathematics, and science), 3 from a small teacher education program at a private university (12 month program); 3 at a large public institution. (9-month program). Both 5th year programs Coding categories are provided</p>	<p>Prospective teachers acknowledge both fieldwork and professional coursework as influential.</p> <p>Teachers report they acquired practical survival skills, general pedagogical knowledge, knowledge of students' understanding from field experiences.</p> <p>Teachers reported that teacher education coursework had its biggest impact on their conceptions of their subject matter for teaching.</p> <p>Teachers report that university coursework had a large impact on their conception of the subject matter they were to teach. They cited their subject-specific courses as influential in shaping their conceptions of how to teach the subject matter.</p> <p>Teachers reported that the university coursework helped them acquire general pedagogical knowledge of theoretical principles related to grouping, mainstreaming, learning, and instruction. They reported that teacher education coursework provided norms for instruction.</p> <p>Teachers reported that their experiences in the field helped them learn about students' understandings of and reactions to the subject matter. Field experiences also helped new teachers learn more about their subject matter.</p>

<p>Grossman, Valencia, Evans, Thompson, Martin, and Place in press) Transitions into Teaching: Learning to Teach Writing in Teacher Education and Beyond <i>Journal of Literacy Research</i></p>	<p>Interpretive and longitudinal study Study of 10 teachers from their last year of preservice teacher preparation into their first two full years of teaching Washington State 5 elementary, 2 middle, 3 high school Interviews (11 per teacher), classroom observations with teachers (5 times over 3 years), principals, cooperating teachers, supervisors, and mentors, group interviews, classroom artifacts</p>	<p>Teacher education provided the teachers with a conceptual framework for teaching writing, the concept of instructional scaffolding, writers' workshop, and a process-orientation toward writing. They acquired a professional language for talking about the teaching of writing, and they used these concepts in their planning and reflection. Teacher education also provided them with a range of instructional strategies including conferencing, journal writing, peer editing, modeling, and author's chair. The curricular materials that they were required to use had an influence on their professional learning and their instruction as first-year teachers. In the second year of teaching, the concepts that had been introduced in teacher education reappeared in the teachers' talk and thinking, at the time when they began to be comfortable with critiquing the materials that they were using. Teacher education provided an image of an ideal practice. The teachers credited teacher education with teaching them how to be reflective about their teaching and to make sense of their successes and failures.</p>
<p>Guyton and Farokhi (1987) Relationships Among Academic Performance, Basic Skills, Subject Matter Knowledge, and Teaching Skills of Teacher Education Graduates <i>Journal of Teacher Education</i></p>	<p>Correlational research Graduates from Georgia State University between 1981 and 1984 Sample ranged from 151 to 411, depending on availability of data. 413 teachers with statewide Teacher Certification Test scores (subject matter knowledge) 273 with Teacher Performance Assessment Inventory scores GPA (sophomore, and upper level) Georgia Regents Test scores (basic skills)</p>	<p>GPA was significantly correlated with teaching success. Basic skill ability is correlated with subject matter knowledge but not related to on-the-job performance. GPA at sophomore year and upon graduation were both positively correlated with teaching performance, although the correlation was stronger upon graduation. Grades in education courses were a stronger predictor of on-the-job success than grades in general knowledge courses. The subject matter test was not correlated with teacher performance as measured on the Georgia Teacher Performance Assessment Instrument, suggesting that one cannot simply do well as a teacher with only subject matter knowledge.</p>

<p>Hawk, Coble and Swanson (1985) Certification: It Does Matter <i>Journal of Teacher Education</i></p>	<p>Comparative/quasi-experimental study (ANOVA, t-tests) Graduates of East Carolina University 36 mathematics teachers of grades 6 – 12 were followed in the study. All were certified. 18 teachers were in-field and 18 were teaching out-of-field; 826 students. Teachers matched on school, teaching the same mathematics course, to students of same ability Students tests: Stanford Achievement Test (general math) and Stanford Test of Academic Skills (algebra) Tests of arithmetic and elementary algebra were administered to teachers. Teaching performance was measured by the CTPAS.</p>	<p>Significant differences were apparent from the post-test in general mathematics and algebra. Students who had in-field teachers scored higher. In-field teachers scored significantly higher on the CTPAS and the knowledge test. Chi-square analysis yielded no significant differences due to years of teaching or degree held by teachers in the study.</p>
<p>Hollingsworth (1989) Prior Beliefs and Cognitive Change in Learning to Teach <i>American Educational Research Journal</i></p>	<p>Interpretive and longitudinal study 3 years 14 preservice teachers, 32 cooperating teachers, 6 university supervisors, and 2 reading course instructors; subject matter is reading. Observations, classroom interviews every two weeks Document analysis Task analysis Teacher journals Supervisor observations Note: <i>Data analysis process described in detail</i></p>	<p>Prospective teachers' preexisting beliefs shaped their interaction with the information presented in the teacher education program.</p>

<p>Monk (1994) Subject Area Preparation of Secondary Mathematics and Science Teachers and Student Achievement <i>Economics of Education Review</i></p>	<p>Survey research and comparative population study (multiple regression) Longitudinal Study of American Youth 51 randomly selected school sites; base sample of 2,829 students; selected localities nationwide 608 mathematics teachers, 483 science teachers Sampling rubric included geographic local and community type (rural, suburban, urban) Teacher survey about number of undergraduate and graduate courses in various curricular areas Student achievement measured by selected NAEP items (1,492 students) at both 10th and 11th grades.</p>	<p>Found positive relationships between the number of undergraduate subject matter courses in a teacher's background and improvement in students' mathematics performance, for both juniors and seniors. For sophomores, teacher course-taking at the graduate level in mathematics also has a positive effect on student achievement. After five mathematics courses, the addition of courses in mathematics has a smaller effect on pupil performance. Mathematics education courses: undergraduate coursework is positively related to improvement in mathematics for sophomores and juniors. Courses in undergraduate mathematics pedagogy contribute more to student performance gains than do undergraduate mathematics courses. Having a mathematics major has no apparent bearing in pupil performance. Teacher undergraduate preparation in the life sciences has no discernible impact on student performance. Positive relationships were found between undergraduate coursework in physical sciences and gains in pupil performance, for both sophomores and juniors. There was a positive relationship between junior gains in achievement and graduate coursework in life sciences. Graduate courses in science pedagogy were positively related to student achievement for sophomores. Undergraduate coursework in science pedagogy had a positive relationship with student achievement for juniors. The magnitudes of the relationships in science between course taking and student gains were quite small. Having a science major was positively related to student gains for juniors. Advanced teacher training was either not related or negatively related to student achievement for science and mathematics for sophomores.</p>
<p>Valli with Agostinelli (1993) Teaching Before and After Professional Preparation: The Story of a High School Mathematics Teacher <i>Journal of Teacher Education</i></p>	<p>Interpretive study One teacher who taught before and after teacher preparation Interviews, observations, and full reflections of the teacher (who is the second author of the paper)</p>	<p>When Agostinelli taught prior to teacher education, he had little classroom control, threatened, and yelled at students. After student teaching and post student teaching, he was soft spoken and respectful in interactions with students and there was little off task behavior. Before teacher preparation, his teaching was teacher oriented, involved a lot of telling, too little planning, lower order questions, and little wait time.</p>

During his supervised student teaching and post-graduation, he was more student oriented, outlined his plans, asked higher-order questions, varied assignments for students, and prompted and then waited for students to respond to questions. He attributed these changes to a range of experiences, including experience, discussions with cooperating teachers, methods classes, educational psychology, and other teacher education coursework.

Question 3: Research or Clinical Experience

Findings

Study Research Tradition Sample Size Variables

<p>Andrew (1990) Differences between Graduates of 4-Year and 5-Year Teacher Preparation Programs <i>Journal of Teacher Education</i></p>	<p>Comparative population study 70-item questionnaire A comparison of random samples of 144, 5-year program graduates and 163, 4-year program graduates from 1976-1986 that provided entry, retention and background data Graduates of teacher education programs at the University of New Hampshire Likert-type scale gave information on 27 factors determined to be important for retention in teaching. Questionnaire was pilot tested on six groups of experienced teachers and subsequently modified.</p>	<p>Entry: Both groups entered teaching at a higher rate than reported in national studies of entry. Retention: 56% of 4-year students and 74% of 5-year students were still teaching. Although it has been reported that academically superior teachers are more likely to leave teaching, this was not true of the 5-year program group who had had higher academic requirements for entering programs. Career Satisfaction: 56% of 4-year students compared to 82% of 5-year students said they'd choose teaching again. Attitudes toward teacher preparation: 5-year students responses showed significant differences showing more positive attitudes toward program and motivation. Yearly evaluations comparison: 1) Allocation of time showed significant differences in 5-year students who had higher estimates for each of the five areas. 2) Ratings of effectiveness of 5-year students consistently rated their own abilities as higher than 4-year students in 11 out of 12 items. Higher retention rate for 5th year program, 74% compared to 56%. Higher career satisfaction. They also rated the program, and their cooperating teachers higher. 5-year students consistently rated their abilities higher than 4-year program grads, especially in organizing and planning class activities, stimulating student interest and conferencing with parents. Found their coursework more valuable.</p>
<p>Borko, Eisenhart, Brown, Underhill, Jones, and Agard (1992) Learning to Teach Hard Mathematics: Do Novice Teachers Give Up Too Easily? <i>Journal for Research in Mathematics Education</i></p>	<p>Interpretive study Case of 1 middle school mathematics teacher in the larger database of 8 teachers who participated in the Learning to Teach Mathematics Study Observations, interviews, observations of university courses</p>	<p>The teacher believed that good mathematics teaching included making mathematics relevant and meaningful. The researchers could not get the teacher to speak about the division of fractions in a meaningful way at the beginning of her student teaching year, and there was little evidence that she had a conceptual understanding of division by fractions. Although her knowledge of fractions seemed to deepen some throughout her participation in a mathematics methods course, she still could not provide a coherent explanation concerning the division of fractions, even after her student teaching experience. During her student teaching, she was unable to realize her image of</p>

<p>Carter and Gonzalez (1993) Beginning Teachers' Knowledge Of Classroom Events <i>Journal of Teacher Education</i></p>	<p>Interpretive study Two elementary student teachers enrolled in a state university teacher preparation program in the western part of the U. S. Interviews (4 during one semester)</p>	<p>good mathematics teaching because her own knowledge of the division of fractions and of how to represent the idea to students in instruction was limited. The teacher education program worked to reinforce the teacher's limited understanding of mathematics and mathematics teaching, rather than questioning it or helping the teacher reinvent her understanding of division of fractions. The university program did not create the conditions for the teacher to overcome the limitations of her own knowledge. One student teacher attended to problems associated with his role in the implementation of curricula and concentrated on watching for cues from students about how and when to alter instruction. The other student teacher focused on her feelings of inadequacy and spent her time eliciting student empathy. While she was successful in gaining student support, the students lost respect for her, and instruction deteriorated.</p>
<p>Clift (1991) Learning To Teach English – Maybe: A Study Of Knowledge Development <i>Journal of Teacher Education</i></p>	<p>Interpretive study One teacher majoring in English at a large urban university Interviews (7 over spring-summer-fall semesters), videotapes of microteaching, teacher journals, and observations <i>Note: Description of how data were categorized is included.</i></p>	<p>Author provides a discussion of three representative events of participant's experiences regarding her subject matter knowledge, classroom confrontation, and status ambiguity. Then she discusses the knowledge schemes that the participant "needed to draw upon as she worked through each incident and the interplay between her prior experiences as a student and the formal instruction she received in university course work" (p. 364). Although findings are not specifically provided, the author says that this case study suggests three related conclusions about the participant's knowledge development (p. 364): 1. Multiple schemata are called upon almost simultaneously when an English teacher begins interacting with students in classrooms. 2. These schemata are not equally well developed, and the gaps in knowledge become apparent when teachers are required to integrate across schemes as they put knowledge into practice. 3. Teacher preparation curricula are not designed to foster knowledge integration across schemes.</p>
<p>Eisenhart, Borko, Underhill, Brown, Jones, and Agard (1992) Conceptual Knowledge Falls Through the Cracks: Complexities of Learning to Teach Mathematics</p>	<p>Interpretive and longitudinal study One teacher who was a senior in a K-8 teacher education program at a large southern university (one of eight teachers studied in the Learning to</p>	<p>The teacher believed that learning arithmetic largely involved memorization. She could not articulate the differences between doing arithmetic and doing mathematics. And she could not provide precise descriptions of arithmetic or mathematics. She believed that teaching for procedural knowledge and teaching for</p>

<p>for Understanding <i>Journal for Research in Mathematics Education</i></p>	<p>Teach Mathematics Project Interviews and observations (in 4 different placements) Part of the Learning to Teach Mathematics Study</p>	<p>conceptual knowledge in mathematics required different kinds of teaching activities. She was less articulate about activities that would lead to the development of conceptual knowledge.</p> <p>She was more confident in her ability to teach procedural aspects of mathematics than conceptual aspects.</p> <p>She taught for procedural knowledge more than for conceptual knowledge.</p> <p>Her own limited knowledge sometimes led her to emphasize procedural knowledge to the exclusion of conceptual knowledge.</p> <p>Her desire to cover the curriculum also limited her emphasis on teaching for conceptual knowledge.</p> <p>In her third student teaching placement, she did put more emphasis on conceptual knowledge. This may have been due to her perceptions of differences between her collaborating teachers.</p> <p>Pressures to prepare students for tests, cover the curriculum, and to use school time to review for tests and practice skills often led to her emphasizing the development of procedural knowledge over conceptual knowledge.</p> <p>In the mathematics methods class that she was enrolled in, the student teachers interpreted the instructor's attempts to teach for understanding and turned them into routines to be memorized and then taught.</p> <p>Student teachers' questions always emphasized the details of specific procedures, not the underlying mathematical ideas.</p> <p>Tensions felt by the student teachers tended to blind them to conceptual knowledge and push them to emphasize the acquisition of teaching activities and procedural knowledge.</p> <p>What the teacher learned in her student teaching was influenced by many factors: her collaborating teachers, the various schools she was placed in, the policies of the school district, her own knowledge of mathematics, and her interpretation of the materials offered in her university methods class.</p>
<p>Eisenhart, Behm, and Romagnano (1991) Learning To Teach: Developing Expertise Or Rite Of Passage? <i>Journal of Education for Teaching</i></p>	<p>Eight middle school math teachers completing a 2-semester student teaching experience Interviews and observations</p>	<p>The program was uncoordinated and incoherent to the participants. The novices found the coursework too theoretical. The standards were high for what they were expected to do – integrate theory and practice, solve their own problems, acquire advanced instructional skills, etc., and they were overwhelmed. In the face of this, they reverted to the culture of their respective schools. They didn't even have minimal teaching skills, and they were expected to be advanced beginners.</p>

<p>Florio-Ruane and Lensmire (1990) Transforming Future Teachers' Ideas About Writing Instruction <i>Journal of Curriculum Studies</i></p> <p>Goodman (1985) What Students Learn from Early Field Experiences: A Case Study and Critical Analysis <i>Journal of Teacher Education</i></p>	<p>Interpretive study Six preservice elementary teachers in a methods class that included field work at a large midwestern university</p> <p>Interpretive study Elementary education program at a large southeastern university¹⁰ elementary preservice teachers Interviews and observations at practicum sites (one to four times)</p>	<p>The teachers entered with clear views of teaching. Teachers provided information, and learning to write involved learning the rules. By observing children learning to write, the novices began to reconstruct their understandings of teaching writing and learning to write.</p> <p>Prior to student teaching, the preservice teachers spent at least four out of five quarters in some early field experiences.</p> <p>The university involvement in the early field experiences was minimal. It was a matter of policy that the university "trusted" the experienced teachers.</p> <p>The heavy emphasis on teaching-to-the-test in the school district shaped the student teachers, who also began to view teaching as the transmission of knowledge from the textbooks in order to prepare students for the test.</p> <p>Cooperating teachers and student teachers reported feeling that they needed to stick with the curriculum and limit any innovation or creativity.</p> <p>Discipline was the most commonly mentioned problem.</p>
<p>Griffin (1989) A Descriptive Study of Student Teaching <i>Elementary School Journal</i></p>	<p>Interpretive and correlational study Two preservice programs; one an undergraduate, one a 5th year masters. 93 elementary and secondary preservice student teachers, 88 cooperating teachers, 17 university supervisors "Intensive" sample of 20 triads of student teachers, cooperating teachers, and university supervisors Background questionnaire Educational Preference Scale Paragraph Completion Test Teacher Concerns Questionnaire Rigidity-Flexibility Index Quick Word Test Internal Locus of Control</p>	<p>Few differences across the two programs.</p> <p>Student teachers were more concerned with others' perceptions of their adequacy than were cooperating teachers.</p> <p>Student teachers scored very low on the vocabulary measures, cooperating teachers were at about the midpoint, and university supervisors at the 63rd percentile.</p> <p>Student teachers showed modest change over the course of student teaching in the following categories:</p> <ol style="list-style-type: none"> 1. a decrease in all stages of concern 2. an increase in flexibility 3. a trend toward educational conservatism regarding educational philosophy <p>There was not change along any other dimension, suggesting that the deep-seated personal beliefs of the student teachers remained intact at the end of student teaching.</p> <p>The specific nature of the school setting appeared to have minimal effect on the student teaching experience.</p> <p>Instructional programs across settings were more similar than different.</p>

	<p>Empathy Construct Rating Scale Self Perception Inventory Group Embedded Figures Test Teacher Work-Life Inventory Outcome measures: expectation scales, performance rating scales, and teacher satisfaction Classroom observations Interviews, documents, scores on standardized tests, post observation audiotapes, journals, conference records from cooperating teachers</p>	<p>Although the contexts in which student teaching took place varied, the experience of student teaching did not. Supervision was dominated by cooperating teachers. Conversations between the student teachers and cooperating teachers seldom involved the discussion of alternative instructional approaches or alternative interpretations of classroom events. Cooperating teachers had two ways of thinking about their work with student teachers: (1) the student teacher needs to learn how to teach the way I do and (2) the student teachers needs to find his or her own way. Conversations focused on classroom management and on specific recommendations from the cooperating teacher about specific classroom practices. There was seldom any mention of underlying principles, learning theory, conceptualizations of teaching, curriculum theories or paradigms, etc. Cooperating teachers did not use codified professional knowledge base. The cooperating teachers and student teachers saw the experience in interpersonal terms, rather than professional ones. Student teachers were very satisfied with the support they got from the cooperating teachers and were generally less satisfied with the university supervisors. There was a lack of evaluative comments. Student teachers tended to focus on the interpersonal aspects of their relationships with their CTs for deciding about the success of their student teaching. There were seldom any end views shared between university faculty and the schoolteachers. Classroom experiences seldom were integrated with university course work. Ratings were universally high for all of the student teachers, and traditional checklists were used. Student teachers were seldom observed in full command of an entire class. Cooperating teachers and student teachers demonstrated little variability in teaching practice. Management of student behavior deteriorated over the course of the semester. Most participants were unaware of the policies, expectations, purposes, and desired practices in regards to student teaching.</p>
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<p>Grisham, Laguardia, and Brink (2000)</p> <p>Partners In Professionalism: Creating A Quality Field Experience For Preservice Teachers</p> <p><i>Action in Teacher Education</i></p>	<p>Interpretive study</p> <p>Five elementary school preservice teachers who were all placed in the same professional development school as part of their participation in a 15-month long master's teacher preparation program in the western U. S.</p> <p>Interviews, student teachers' journals, observations, and action research projects conducted by the student teachers and their collaborating teachers</p>	<p>Eight factors contribute to a quality field experience:</p> <ol style="list-style-type: none"> 1. year-long experience 2. clustering of student teachers 3. on-site literacy classes 4. teacher study groups and action research 5. enhanced supervision of student teachers by a university supervisor who was intimately involved with the PDS. 6. steering committee in the school that consisted of the principal and any interested teachers, the student teachers, their collaborating teachers, and the university faculty. 7. second experience: some of the interns went to another classroom for the second half of the year. 8. the status of the interns: because they were in the school all year, they felt and were treated more like co-teachers than like "student" teachers.
<p>Grossman and Richert (1988)</p> <p>Unacknowledged Knowledge Growth: A Re-examination of the Effects of Teacher Education</p> <p><i>Teaching and Teacher Education</i></p>	<p>Interpretive study</p> <p>Two-year study as part of the Knowledge Growth in a Profession Project in the Bay Area in California</p> <p>Interviews and observations</p> <p>Six preservice secondary teachers, 3 in a small teacher education program at a private university (12 month program); 3 at a large public institution. (9-month program). Both 5th-year programs</p>	<p>Teachers report they acquired practical survival skills, general pedagogical knowledge, knowledge of students' understanding from field experiences.</p> <p>Teachers report that university coursework had a large impact on their conception of the subject matter they were to teach. They cited their subject-specific courses as influential in shaping their conceptions of how to teach the subject matter.</p> <p>Teachers reported that the university coursework helped them acquire general pedagogical knowledge of theoretical principals related to grouping, mainstreaming, learning, and instruction. They reported that teacher education coursework provided norms for instruction.</p> <p>Teachers reported that their experiences in the field helped them learn about student understandings of and reactions to the subject matter. Field experiences also helped new teachers learn more about their subject matter.</p>
<p>Grossman, Valencia, Evans, Thompson, Martin, and Place (in press)</p> <p>Transitions into Teaching: Learning to Teach Writing in Teacher Education and Beyond</p>	<p>Interpretive and longitudinal study</p> <p>Study of 10 teachers from their last year of preservice teacher preparation into their first two full years of teaching</p> <p>Washington State</p>	<p>Prospective teachers learned from the field when they were asked to focus their time in field assignments collecting data for mini-action research projects.</p> <p>When student teachers belonged to a cohort, they reported that that helped them learn from their field experiences.</p> <p>The nature of student teaching varied widely across the participants in</p>

<p><i>Journal of Literacy Research</i></p>	<p>5 elementary, 2 middle, 3 high school Interviews (11 per teacher), classroom observations with teachers (5 times over 3 years), principals, cooperating teachers, supervisors, and mentors, group interviews, classroom artifacts</p>	<p>the program and the cooperating teachers played a critical role. One kind of student teaching experience involved a reflective partnership in which the novice was encouraged to experiment and inquire. At the other end of the spectrum were more classic relationships where the student teacher was meant to apprentice to the practices of the cooperating teacher. The former worked to develop more reflective teachers, the latter worked if there was a philosophical alignment between the teacher and the novice.</p>
<p>Hollingsworth (1989) Prior Beliefs and Cognitive Change in Learning to Teach <i>American Educational Research Journal</i></p>	<p>Interpretive and longitudinal study Three years 14 preservice teachers, 32 cooperating teachers, 6 university supervisors, and 2 reading course instructors; subject matter is reading Observations, classroom interviews every two weeks Document analysis Task analysis Teacher journals Supervisor observations <i>Note: Data analysis process described in detail.</i></p>	<p>Changes in preservice teachers' thinking from global views of teaching in classrooms to understandings about context-specific student learning from text could be traced in predictable patterns. Findings suggested that:</p> <ol style="list-style-type: none"> 1. Preprogram beliefs served as filters for processing program content and making sense of classroom contexts. 2. General managerial routines had to be in place before subject specific content and pedagogy became a focus of attention. 3. Interrelated managerial and academic routines were needed before teachers could actively focus on students' learning from academic classroom tasks. Regardless of their subject matter knowledge, novices who failed to routinize management and instruction failed to understand what students were learning. <p>Factors that the research team suggest accounted for intellectual change (or the lack thereof) is described through partial case studies of four preservice teachers participating in the study:</p> <ol style="list-style-type: none"> 1. their images of themselves as teachers; 2. an awareness that they needed to temper initial beliefs and come to terms with classroom management; 3. the presence of a cooperating teacher as a role model that facilitated growth; and 4. placement with a cooperating teacher whose ideas and practices were somewhat different than those of the prospective teacher.
<p>Lazar (1998) Helping Preservice Teachers Inquire About Caregivers: A Critical Experience for Field-Based Courses <i>Action in Teacher Education</i></p>	<p>Interpretive study 15 elementary preservice teachers who participated in a semester long literacy practicum in a Philadelphia elementary school Cultural Diversity Awareness Inventory, Teachers' papers, reflections, interviews with 6 of them, and observations</p>	<p>At the beginning of the term, most of the preservice teachers either were not sure or doubted that poor, inner-city parents read to their children, taught them to read, or bought them books. After 10 weeks of interviewing, teaching, and observing children and caregivers, 50% of the student teachers believed that inner-city parents read to their children and supplied books; 30% believed that parents brought their children to the library; 15% were more willing to believe that caregivers taught their children to read. What the student teachers learned from their field experiences was shaped by their attitudes and beliefs.</p>

<p>Metcalf, Hammer, and Kahlich (1996)</p> <p>Alternatives to Field-Based Experiences: The Comparative Effects of On-Campus Laboratories</p> <p><i>Teaching and Teacher Education</i></p>	<p>Quasi-experimental, comparative study</p> <p>37 prospective secondary teachers enrolled in general methods courses at a large, midwestern public university</p> <p>They were assigned to two different kinds of clinical experiences. One group (N=16) had field placements in one of two junior high schools. The other group (N=21) participated in laboratory experiences on campus that were designed to play the role of field experience but in a more controlled environment.</p> <p>Student work was collected; written case analysis as pretest; videotapes of them teaching mini-lessons; daily logs, student papers</p>	<p>The laboratory setting was effective in improving preservice teachers' ability to identify and explain critical pedagogical events in written cases, whereas the field experience resulted in slightly negative changes.</p> <p>There was no significant difference in the groups in their ability to organize instruction. Laboratory teachers were found to improve significantly in their ability to perform during instruction.</p>
<p>Schelske and Deno (1994)</p> <p>The Effects of Content-Specific Seminars on Student Teachers' Effectiveness</p> <p><i>Action in Teacher Education</i></p>	<p>Correlational study</p> <p>26 student teachers enrolled in a 4-year private liberal arts college in Minnesota</p> <p>The participants were randomly assigned to three seminar conditions: coping skills, classroom management, and educational discussion.</p> <p>Classroom observations</p> <p>Component rating scales</p> <p>Student Teacher Evaluation Scale</p> <p>Student Engagement Ratings Scale</p>	<p>Student teachers in the classroom management and coping skills seminars demonstrated significantly higher classroom management skill in their teaching than did the student teachers in the discussion seminar ($p < .01$). Student teachers in those two groups also demonstrated significantly higher faculty ratings of their overall effectiveness ($p < .05$), and lower percentages of pupil off-task behavior ($p < .06$).</p>
<p>Shulman (1987)</p> <p>From Veteran Parent to Novice Teacher: A Case Study of a Student Teacher</p> <p><i>Teaching and Teacher Education</i></p>	<p>Interpretive study</p> <p>One 9th grade English preservice teacher at a large midwestern university</p> <p>1 cooperating teacher</p> <p>2 validating informants (student teachers in a 6th grade classroom)</p> <p>Observations and interviews</p>	<p>Over the year, the teacher passed through many of the standard phases of traditional student teachers, ranging from frustration and despair to confidence and success.</p> <p>In difficult situations, the teacher relied on life experience as a coping mechanism. Phases were identified as observer role, active teaching, trial and error, consolidation and integration. She accepted a passive observer role initially—adopting a "strategic compliance" posture with her cooperating teacher and later was allowed to develop her own instructional style and material.</p>

<p>Tabachnick, Popkewitz, and Zeichner (1979-1980) Teacher Education and The Professional Perspectives Of Student Teachers <i>Interchange</i></p>	<p>Interpretive study 85 student teachers enrolled in the elementary education program at a large midwestern university 12 were then identified as intensive case studies Observations and interviews</p>	<p>A large part of the problem faced by the teacher was a hands-off cooperating teacher who offered nothing in the way of advice or commentary. The curriculum was also bland and impoverished. The student teacher struggled to create an improved learning environment, a task that might have been easier to achieve had she more training in teacher education. In the end the teacher earned respect from the students and a measure of success in implementing a richer curriculum that was more student focused than the approach with which she had started.</p>
		<p>Student teaching involved a very limited range of classroom activities. Typically, they were engaged in routine and mechanical aspects of teaching: teaching short-term skills, testing or grading children, and helping make sure that children move through lessons in an orderly way. Student teachers largely taught in a mechanical fashion and did not question the norms of the school or the traditional and narrow approach to curriculum taken by the teachers. Workbooks and worksheets dominated the student teachers' classrooms. The activities they would do were already prescribed before they went to the school, and the materials were also largely prescribed. Student teachers' interactions with students tended to be brief and impersonal, largely limited to the small technical tasks that they were working with the students on. Student teachers often took on a passive role in their interactions with the cooperating teachers. There was also evidence that the student teachers avoided conflict with their cooperating teachers. The university seminars that the student teachers were involved in emphasized being reflective, autonomous, responsible, and active. Yet those themes were in contradiction with what actually happened in the seminars, for the seminars largely supported the on-going and constrained field experiences that the student teachers actually had. Thus, instead of being in competition with one another, the university and the schools together created a powerful force in supporting the status quo. The student teachers said that they wanted to be different than their cooperating teachers and to have interesting and exciting classrooms. But in their actions, they accepted a routinized teaching mode that was familiar.</p>

<p>Tabachnick and Zeichner (1984) The Impact of the Student Teaching Experience on the Development of Teacher Perspectives <i>Journal of Teacher Education</i></p>	<p>Interpretive study 13 elementary student teachers enrolled in a teacher education program at a large midwestern university Teacher Belief Inventory Observations and interviews</p>	<p>The researchers identified 18 dilemmas faced by the student teachers. These dilemmas clustered in 4 domains: knowledge and curriculum, teacher-pupil relationships, the teacher's role, and student diversity. They used these dilemmas to characterize each student teacher's perspective, and then they examined the impact of student teaching on the student teachers' perspectives. Student teaching did not result in a homogenization of student teachers' perspectives. The student teaching experience did not significantly alter the perspectives that student teachers brought with them. On the contrary, for 10 of the 13 student teachers, the student teaching experience solidified their perspectives, and student teachers became more articulate in their ability to express their views. Student teachers developed a more realistic view of the work of teaching and the teacher's role. Student teachers grew increasingly comfortable with their beliefs about teaching and their abilities to handle a classroom in their preferred styles. Student teachers' intentions played a significant role both in the placement they selected for their student teaching and in their reactions to their student teaching experiences.</p>
<p>Wilson (1996) An Evaluation of the Field Experiences of the Innovative Model for the Preparation of Elementary Teachers for Science, Mathematics, and Technology <i>Journal of Teacher Education</i></p>	<p>Interpretive study (ANOVA and descriptive statistics) 26 preservice teachers who participated in an NSF-sponsored elementary teacher education program at Kansas State University Science Teacher Efficacy Belief Inventory Field Experience Evaluation Form Interviews (all were administered twice)</p>	<p>The field experiences were part of educational methods classes and took five forms: after-school club experiences, classroom team presentations, teacher observations and case studies, professional development activities, and special events. The field experiences took place in 3 professional development schools. The self-efficacy of preservice teachers increases with field experiences that are clearly defined, planned and practiced ahead of time, and logically sequenced. Field experiences that allowed preservice teachers to participate in teams were more beneficial than professional development opportunities.</p>

Question 4: Research on Teacher Education Policies

Findings

Study Research Tradition Sample Size Variables

Study	Research Tradition Sample Size Variables	Findings
<p>Andrew (1990) Difference between Graduates of 4-Year and 5-Year Teacher Preparation Programs <i>Journal of Teacher Education</i></p>	<p>Comparative population study 70-item questionnaire A comparison of random samples of 144, 5-year program graduates and 163, 4-year program graduates from 1976-1986 that provided entry, retention and background data Graduates of teacher education programs at the University of New Hampshire Likert-type scale gave information on 27 factors determined to be important for retention in teaching. Questionnaire was pilot tested on six groups of experienced teachers and subsequently modified.</p>	<p>Entry: Both groups entered teaching at a higher rate than reported in national studies of entry. Retention: 56% of 4-year students and 74% of 5-year students were still teaching. Although it has been reported that academically superior teachers are more likely to leave teaching, this was not true of the 5-year program group who had had higher academic requirements for entering programs. Career Satisfaction: 56% of 4-year students compared to 82% of 5-year students said they'd choose teaching again. Attitudes toward teacher preparation: 5-year students responses showed significant differences showing more positive attitudes toward program and motivation. Yearly evaluations comparison: 1) Allocation of time showed significant differences in 5-year students who had higher estimates for each of the five areas. 2) Ratings of effectiveness of 5-year students consistently rated their own abilities as higher than 4-year students in 11 out of 12 items. Higher retention rate for 5th year program, 74% compared to 56%. Higher career satisfaction. They also rated the program, and their cooperating teachers higher. 5-year students consistently rated their abilities higher than 4-year program grads, especially in organizing and planning class activities, stimulating student interest and conferencing with parents. Found their coursework more valuable.</p>
<p>Darling-Hammond (2000) Teacher Quality And Student Achievement: A Review Of State Policy Evidence. <i>Education Policy Analysis Archives</i></p>	<p>Survey and comparative population study (multiple regression and partial correlations) 1993-94 School and Staffing Survey (SASS) 65,000 teachers Data on NCATE certification collected from 50 states State average NAEP scores in mathematics: grade 4 in 1990, 1996;</p>	<p>A state's average of NAEP scores in reading and mathematics was positively associated with the state's percentage of well-qualified teachers (full certification and major in their field). A state's average of NAEP scores in reading and mathematics was negatively associated with the state's percentage of teachers out of field (less than a minor in the field they teach). A state's average of NAEP scores in reading and mathematics was positively associated with the state's percentage of fully certified teachers. A state's average of NAEP scores in reading and mathematics was negatively associated with three indicators of the state's percentage of</p>

	<p>grade 8 1992, 1996</p> <p>State average NAEP scores in reading: grade 4 in 1992, 1994</p> <p>State is unit of analysis.</p>	<p>less than fully certified teachers: % of all teachers less than fully certified, % of new entrants to teaching who are uncertified (excluding transfers), % of all newly hired teachers uncertified.</p> <p>The percentage of teachers with both a major and full certification in their field was positively correlated with the percentage of teacher education institutions in a state not NCATE accredited.</p>
<p>Gitomer & Latham (1999)</p> <p><i>The Academic Quality of Prospective Teachers: The Impact of Admissions and Licensure Testing.</i></p> <p>Princeton, NJ: Educational Testing Service.</p>	<p>Comparative study (multiple regression)</p> <p>National probability sample</p> <p>Study of teacher education student test scores and information on teacher education institutions</p> <p>Overall sample includes over 300,000 students who took Praxis in 1994-97</p> <p>Data sources: ETS Praxis I and II examinations scores; college entrance SAT and ACT scores; NCATE status of candidate's institution; state passing status</p>	<p>Teachers did better on the certification tests if they attended institutions that had been approved by the national accrediting association.</p>
<p>Prestine (1991)</p> <p>Political System Theory as an Explanatory Paradigm for Teacher Education Reform.</p> <p><i>American Educational Research Journal</i></p>	<p>Interpretive study of one college of education's experience with a change in state policy</p> <p>University of Wisconsin Madison and the Wisconsin Department of Public Instruction</p> <p>Document analysis, interviews</p>	<p>Change in state law concerning the role of the state in approval of teacher preparation programs leading to certification or licensure resulted in a sustained conflict between UW-M and WDPI and eventually in changes in UW-M teacher education program.</p> <p>The state government was able to produce change in the teacher education program, even in an institution with a strong and well-defined teacher education program.</p>
<p>Wenglinsky (2000)</p> <p><i>Teaching the Teachers: Different Settings, Different Results.</i></p> <p>Princeton, NJ: Educational Testing Service</p>	<p>Comparative study (multiple regression)</p> <p>Study of teacher education student test scores and institution survey responses</p> <p>Sample size: 152 institutions; 40,000 teacher education students</p> <p>Data sources: ETS Praxis II examinations scores; NCES Integrated Postsecondary Educational Data System; college entrance SAT scores and ACT scores; survey of institutions</p> <p>Southeastern US</p>	<p>Teachers did better on the certification tests if they attended institutions that:</p> <ol style="list-style-type: none"> 1. had a relatively low proportion of the institution (budget and numbers of education majors and minors) devoted to teacher preparation 2. had a relatively high proportion of traditional (i.e., full-time, 24 years old or younger) students 3. were private rather than public 4. had an ethnically diverse faculty

Question 5: Research on Alternate Routes

Study	Research Tradition Sample Size Variables	Findings
<p>Goldhaber and Brewer (2000) Does Teacher Certification Matter? High School Teacher Certification Status and Student Achievement <i>Educational Evaluation and Policy Analysis</i></p>	<p>Survey and comparative population study (multiple regression) National Educational Longitudinal Survey 1988 3,786 students in mathematics 2,524 students in science 2,098 mathematics teachers 1,371 science teachers 10th and 12th grade standardized test scores in mathematics and science is the outcome variable. Independent variables are grouped into:</p> <ul style="list-style-type: none"> • individual and family background characteristics of students • schooling resources, which include school, teacher, and class specific variables. <p>Teacher variables include type of certification (standard subject, probationary subject, private school, none), degree level, and experience</p>	<p>Students with teachers who hold standard certification or private school certification in their subject have 12th grade math tests with scores between 7 to 10 points higher than students of teachers with probationary or emergency certification, or who are not certified. Similar results were found for student achievement on a 10th grade mathematics test.</p> <p>The results were similar for science, but are less pronounced.</p> <p>Students from lower SES backgrounds tend to get teachers who have emergency or probationary credentials, or no certification. Thus, students are not randomly distributed across teachers by type of certification.</p> <p>Students who do poorly in 10th grade are more likely to be assigned to a teacher who does not have standard certification in mathematics in 12th grade.</p> <p>Students with teachers who had degrees in mathematics were found to have higher test scores relative to those with teachers with out-of-subject degrees. In science, there was no effect.</p> <p>Math students with teachers with bachelor's or master's degrees in mathematics have higher test scores relative to those with out-of-subject degrees.</p> <p>There is no significant relationship between teacher subject matter major and student achievement in science.</p> <p>Having a degree in education had no impact on student science scores, but a BA in education had a negative impact on mathematics achievement.</p> <p>Students of teachers who have standard certification or emergency certification have higher math scores than students whose teachers have private school certification or no certification. The effects are not as strong in science but do follow the same trends.</p>
<p>Grossman (1989) Learning to Teach Without Teacher Education <i>Teachers College Record</i></p>	<p>Interpretive study 3 teachers who did not go through teacher education (2 with BAs in literature, one completing a doctorate)</p>	<p>The teachers found it hard to reconceptualize English as a school subject and to rethink it so as to make it accessible to their students.</p> <p>The teachers also found it difficult to anticipate student knowledge and potential difficulties.</p>

<p>Guyton, Fox, and Sisk (1991) Comparison of Teaching Attitudes, Teacher Efficacy, and Teacher Performance of First Year Teachers Prepared by Alternative and Traditional Teacher Education Programs <i>Action in Teacher Education</i></p>	<p>First-year teachers of English in schools in the San Francisco Bay area. Interviews (five) and classroom observations from the Knowledge Growth in a Profession Project</p>	<p>The teachers explained away teaching difficulties with lack of student motivation and unwillingness to work hard. The teachers rely heavily on memories of themselves as students. The teachers used teaching strategies that they had experienced as learners. Sometimes these were college models and inappropriate for their high school students. The teachers shared a "conception of teaching that presupposes bright, motivated students who are eager to learn from a knowledgeable teacher" (p. 200). For the teachers, planning meant subject matter preparation (reading the book or the play), not thinking through how students would best learn it.</p>
<p>Houston, Marshall, and McDavid (1993) Problems of Traditionally Prepared and Alternately Certified First-Year Teachers <i>Education and Urban Society</i></p>	<p>Comparative and survey study 3 beginning teachers in an Alternative Preparation Institute (AC teachers) and 26 beginning teachers prepared in traditional teacher preparation (RC teachers) in Georgia AC teachers nominated and then invited to participate in research; no information about how RC teachers were selected Attitude Inventory (14 open-ended items) Educational Attitudes Inventory (Likert scale) Teaching Attitudes Inventory (Likert scale) Teacher Efficacy Scale Beginning Teachers Evaluation Form (completed by mentors, peers, principals) At the end of the year, the sample dropped to 11 AC teachers and 15 RC teachers.</p>	<p>39% of the AC teachers were African-American; 8% of the RC teachers were. Comparable on other dimensions, including SES, subject area, and gender. No statistical differences between AC and RC GPA or teacher certification test score. No significant differences between the two groups in mean evaluation scores. The AC teachers were significantly more positive about their teacher preparation program. No significant differences in educational attitudes or in evaluation of self-efficacy as a teacher. AC teachers felt at least as efficacious as the RC teachers. No significant differences in self-efficacy or educational attitudes. RC teachers were more positive about staying in the profession. Five AC teachers quit teaching before the year was over. AC teachers had mentors to support their induction; RC teachers did not.</p>
	<p>Comparative study 69 regularly certified elementary teachers and 162 alternatively certified first year teachers in the Houston Independent School District Survey instrument to assess teachers'</p>	<p>Traditionally certified teachers were more likely to be female (p= .0001), younger (p= .0001), single and White. AC teachers were more likely to be teaching children of color (p= .002). TC teachers were more likely to be teaching in the area in which they were certified (p= .001).</p>

<p>Hutton, Lutz, and Williamson (1990) Characteristics, Attitudes, and Performance of Alternative Certification Interns <i>Education Research Quarterly</i></p>	<p>perceptions of problems, assistance of mentors, and confidence, satisfaction, and future plans, administered after 2 and 8 months of teaching</p>	<p>The researchers also found that after 2 months of teaching, alternatively certified teachers perceived significantly greater problems with student motivation, managing teacher time, the amount of paperwork, grading students, lack of personal time, and school administration. Six months later, after 8 months of teaching, these differences had all but disappeared. There were no differences in their confidence as teachers, and after 8 months of teaching, there were no significant differences in their view of the effectiveness of mentors' assistance, their satisfaction with teaching as a career, in their plans to keep teaching, or their intention to be teaching 5 years hence.</p>
<p>Hutton, Lutz, and Williamson (1990) Characteristics, Attitudes, and Performance of Alternative Certification Interns <i>Education Research Quarterly</i></p>	<p>Comparative study 110 interns in the Dallas Independent School District Alternative Certification Program which is a collaboration between the school district and East Texas State University Teacher Worklife Inventory Teacher Concerns Checklist Survey of Mainstreaming Options Comparison group of 62 traditionally prepared first-year teachers TTAS (the statewide teacher performance evaluation) ExCET (the statewide certification exam) TACRF (ratings by teacher advisors comparing interns to average first-year teachers)</p>	<p>AC interns became significantly more concerned about the task of teaching after a semester in the classroom. And less concerned about self and impact on students. ($p < .01$) AC interns became significantly less positive about mainstreaming ($p < .01$). 11 interns dropped out. In the remaining 99, there was a higher percentage of minority teachers than in a comparison group of 62 traditionally prepared first-year teachers. There was no change during training on the TWLI. The first year teachers were younger than the AC interns ($p < .05$). There was no significant difference in the SES of the schools in which they were teaching. On two dimensions of the Worklife Inventory, the AC interns found their work significantly less rewarding and more complex ($p < .05$). Almost all of the AC interns met or exceeded expectations on the TTAS. Intern passing rates on five of the seven different ExCET examinations were higher than the statewide passing rates. (The sample sizes for test-takers ranged from 1 to 60).</p>
<p>Jelmsberg (1996) College-Based Teacher Education Versus State-Sponsored Alternative Programs <i>Journal of Teacher Education</i></p>	<p>Comparative and survey study Random sample of 492 New Hampshire elementary and secondary school teachers certified between 1987 and 1990. 236 usable teacher surveys 136 usable principal surveys Approximately 200 RC teachers, 30</p>	<p>AC teachers came from Alternative 4 graduates assume full responsibility for students prior to teacher preparation and have 3 years to complete a professional development plan. RC teachers came through a 4-year traditional program, or a 5-year traditional program that includes a yearlong internship. Teachers from the teacher education programs rated their professional preparation in teaching methods and education foundations higher than did AC teachers ($p < .02$), as well as their supervision and their overall preparation.</p>

<p>Lutz and Hutton (1989) Alternative Teacher Certification: Its Policy Implications for Classroom and Personnel Practice <i>Educational Evaluation and Policy Analysis</i></p>	<p>AC teachers Questionnaire to gather program evaluations from teachers and to gather evaluations from principals; also surveyed academic credentials, professional courses, and practicum supervision</p> <p>Comparative study, survey Evaluation of the alternative teacher certification program in the Dallas Independent School District, including comparisons and regression analysis 110 interns in program; 99 in sample, compared to 62 first year teachers Various measures, including demographic information, basic skills test, Texas Teacher Appraisal System, Teacher Advisor Comparison Rating Form, Teacher Work-Life Inventory, ExCET (statewide certification exam), Teacher Concerns Checklist, Survey of Mainstreaming Options</p>	<p>Principals rated the RC teachers significantly higher on instructional planning ($p < .05$) and on instructional skills ($p < .04$). A significantly higher percentage of AC teachers assessed the district staff as valuable. 26 of the 27 significant differences found in the study favored traditional teacher preparation.</p>
		<p>Some description of the program elements is provided. The average age was 31.3 years, 38% were white, 34% Black, 25% Hispanic. Their average GPA in their undergraduate work was 3.135. When compared to first-year teachers in their same district, the alternatively certified teachers were older and more diverse ethnically or racially ($p < .01$). There were no significant differences in the SES of the schools to which they were assigned, although more alternatively credentialed teachers were teaching in secondary schools. First-year teachers reported a higher commitment to teaching as a profession and planned to stay in teaching longer than AC interns. When rated by their mentors, the alternatively certified teachers got high evaluations on their performance as teachers. 91.8% were rated as performing as well as, superior to, or very superior to the typical first-year teacher in the district. When compared to the statewide average of first-year teachers, the 99 AC teachers who completed the program had higher test scores on the ExCET, the statewide test for teacher subject matter knowledge. Teacher advisors generated a list of specific suggestions for improving the DISD Intern program. 59 of the 99 interns were recommended for certification; 24 were required to make up deficiencies in their files. Principals rated beginning teachers higher than AC interns on reading, discipline management, classroom management, planning, instructional techniques, and instructional models. About 25% of AC interns admitted to choosing teaching because of lack of success in first career, in comparison with 96% of first year teachers.</p>

<p>McDiarmid and Wilson (1991) An Exploration of the Subject Matter Knowledge of Alternate Route Teachers: Can We Assume They Know Their Subject? <i>Journal of Teacher Education</i></p>	<p>Interpretive and survey study N=55 Undergraduate degrees in mathematics 8 in the intensive sample All in two alternate routes Another 8 intensive sample interviewees who majored in something else but were to be elementary school teachers Questionnaire and interviews</p>	<p>In general, prospective teachers did well on rules of thumb in mathematics but could not explain how those rules worked or represent problems accurately.</p>
<p>Miller, McKenna, and McKenna (1998) A Comparison of Alternatively and Traditionally Prepared Teachers <i>Journal of Teacher Education</i></p>	<p>Comparative and interpretive study Study 1: 41 AC teachers matched with 41 TC teachers. The AC graduates came from a program for middle school teachers at a southeastern university. The study took place after all teachers had 3 years of classroom experience. Matched on subjects taught, grade level, and school Classroom evaluation rating scale (trained observers) Study 2: 18 5th and 6th grade classrooms, selected from teachers in study 1. 188 students of AC teachers, 157 students of RC teachers Iowa Test of Basic Skills Study 3: Interviews about perceptions of teaching abilities of the 82 teachers from Study 1. Trained interviewers</p>	<p>Study 1: No significant differences in teaching behaviors between AC and RC teachers. MANOVA analyses suggest that the differences obtained in the study were due to sampling variability and do not reflect true differences in the populations. Study 2: No difference in average student achievement. Study 3: Neither group felt more prepared than the other; neither felt particularly well prepared. Discipline and classroom management were the two most commonly cited problems. Both groups felt competent after 3 years of experience.</p>

<p>Sandlin, Young, and Karge (1992) Regularly and Alternately Credentialled Beginning Teachers: Comparison and Contrast of Their Development <i>Action in Teacher Education</i></p>	<p>Comparative, survey, and longitudinal study 66 beginning teachers and 58 interns randomly selected from a pool of teachers at a California State University campus; interns were part of a California University Intern Credential AC program. All of the interns had two years of paid field experience prior to teaching. Teacher Evaluation Scale and classroom observation of teachers Teacher Concern Survey 13% were interviewed by phone</p>	<p>In the fall, RC teachers were rated significantly lower in classroom observations than the AC teachers on 5 of 16 items ($p < .05$). By midyear, they were rated significantly lower on 2 of the 16 items. At the end of the year, there were no significant differences between the groups. 15 teachers were interviewed by phone. AC teachers struggled most with paperwork, time, and organization. RC teachers were concerned with self-confidence and organization. By the end of a year, both groups felt prepared to teach. RC teachers credited their teacher preparation program; AC teachers credited their experience. RC teachers listed self-concerns (e.g., evaluation) as highest; AC listed task and self-concerns as highest. RC teachers showed more concern about all elements of their teaching ability.</p>
<p>Shen (1997) Has the Alternative Certification Policy Materialized Its Promise? A Comparison Between Traditionally and Alternately Certified Teachers in Public Schools <i>Educational Evaluation and Policy Analysis</i></p>	<p>Survey research Schools and Staffing Survey 1993-94 (SASS93) Relative weighted sample includes 14,719 teachers (13,602 RC teachers; 1,119 AC teachers)</p>	<p><i>Note: This analysis is based on the same data set and reports largely the same findings as Shen (1998a, b)</i> There was little difference between AC and RC teachers in terms of gender. There were significantly more non-White teachers in the AC group than in the RC group ($p < .001$). Higher percentage of those under the age of 30 in the AC teachers, and a higher percentage of teachers 50 or older in the RC group. Higher percentage of RC teachers (99%) had BAs than AC teachers (96.7%) ($p < .001$). RC teachers also had a higher percentage of MAs. Higher percentage of AC teachers at the secondary level and in large central cities. Higher percentage of AC teachers taught in schools where 50-100% of the students were from minority groups. Higher percentage of AC teachers taught secondary mathematics and science, and higher percentage had degrees in these subjects, plus engineering. Higher percentage of RC teachers intend to stay in teaching until retirement.</p>

<p>Shen (1998a) Alternative Certification, Minority Teachers, and Urban Education <i>Education and Urban Society</i></p>	<p>Survey research Schools and Staffing Survey 1993-94 (SASS93) Relative weighted sample includes 14,719 teachers (13,601 RC teachers; 1,118 AC teachers) Data extracted from Public School Teacher Questionnaire Examination of characteristics of AC minority teachers and TC and AC White teachers.</p>	<p><i>Note: This study repeats the same findings as Shen, 1998b. Thus, they should not be counted as separate studies.</i></p> <p>AC recruits a significantly higher percentage of minority teachers ($p < .001$). No significant differences in proportion by gender.</p> <p>A very high percentage of minority teachers teach in urban schools, especially AC minority teachers.</p> <p>AC attracts a higher percentage of White teachers who are less than 30 years old, but a higher percentage of minority teachers who are in their 40s.</p> <p>AC attracts a significantly higher number of teachers who have previous work experience.</p> <p>3% of both AC White and AC minority teachers do not possess a BA ($p < .001$).</p> <p>10% of AC minority teachers have educational attainment of an MA or above. The percentage of those teachers having a MA is higher among AC minority teachers than among any other group of teachers.</p> <p>Significantly higher percentage of AC teachers teach mathematics or science, but there is no significant difference between AC and RC teachers in terms of whether they receive a bachelor's degree in mathematics, science, or engineering. So a higher percentage of AC teachers are teaching out of subject area.</p> <p>Significantly higher numbers of AC minority teachers do not plan to stay in teaching.</p>
<p>Shen (1998b) The Impact of Alternative Certification on the Elementary and Secondary Public Teaching Force <i>Journal of Research and Development in Education</i></p>	<p>Survey research Schools and Staffing Survey 1993-94 (SASS93) Relative weighted sample includes 14,719 teachers (13,601 RC teachers; 1,118 AC teachers)</p>	<p>No significant differences in gender</p> <p>Significantly higher number of minority teachers, both at the secondary level ($p < .005$) and elementary ($p < .001$)</p> <p>Significant differences in terms of age, with AC teachers being older at both the elementary (.001) and secondary (.01) levels.</p> <p>Significantly more AC teachers in large central cities, but there is no significant difference in rural areas.</p> <p>Significantly more AC teachers work in schools where minority students make up 50-100% of the student population, at elementary and secondary levels.</p> <p>Significantly higher percentage of AC teachers teach mathematics or science, but there is no significant difference between AC and RC teachers in terms of whether they receive a BA in mathematics, science, or engineering. So a higher percentage of AC teachers are teaching out of subject area.</p>

<p>Stoddart (1990) Los Angeles Unified School District Intern Program: Recruiting and Preparing Teachers for an Urban Context <i>Peabody Journal of Education</i></p>	<p>Interpretive study Case study of one alternative route Los Angeles Unified School District, and some comparisons Demographic data from the district, including analysis of transcripts Interviews and observations from the Teacher Education and Learning to Teach Study (TELT) from the National Center for Research on Teacher Education Comparisons to AACTE RATE III survey. 1,100 new teachers recruited into LAUSD via intern program in 6 year period 855 still teaching in 1990 at the time of the analysis</p>	<p>No difference in whether AC and RC elementary teachers have a BA. A significant difference was found between AC teachers without a BA (6.4%) and TC teachers without a BA (1.4%) A significantly higher percentage of AC teachers do not have a MA. A significantly higher percentage of AC teachers had education-related experiences prior to teaching than RC teachers, at both the elementary and secondary levels</p>
	<p>1,100 teachers in 6 years were recruited in English, mathematics, science, elementary, and bilingual education. 30% dropped out in within that 6-year timeframe. It is unclear whether they left teaching. Number of emergency credentialed teachers dropped from 47 to 34%. It is a requirement of the program that the interns have a baccalaureate degree in an academic major and 20 semester hours in the subject to be taught; they must pass NTE with a score of 660. GPAs of the AC interns compared favorably with the general population of teacher education graduates. The majority of the secondary interns graduated from academically rigorous universities. Only 9% had GPAs below 2.75. The attrition rate of LAUSD interns in the first three years of teaching is lower than would be expected on the basis of national figures. Low percentages of AC interns had work experience in an occupation related to their academic area, in mathematics and English. The number of interns coming into teaching from science occupations is relatively high. The AC interns had higher percentages of males and of minority teachers than typical college-based programs. AC interns have more experience living in urban settings than their RC colleagues, and they hold higher expectations for low income and minority students when compared to a national database collected by NCRTE. The amount of time in coursework for the AC interns is equivalent to the teacher preparation requirements in CA, and the content of the coursework is similar to that of college programs. However, the program was not academically rigorous, for attendance was the only requirement for passing the courses. The program also focused exclusively on preparing teachers to teach the LAUSD curriculum and to succeed in the LAUSD schools. The elements of the training included: preservice orientation to</p>	

LAUSD; inservice modules, multicultural education, and mentoring. Evaluation is focused on ability to teach.

There were no significant differences in the mathematics knowledge of the interns when compared to a national sample of teacher education graduates. AC and RC teachers alike had mastery of computational skills but demonstrated difficulties explaining how and why algorithms worked or how to represent mathematical problems.

The RC English teachers were significantly more knowledgeable about specific approaches to teaching writing, although the RC teachers abandoned those pedagogies when faced with the challenges of teaching in urban and high poverty settings.

AC interns held higher expectations for low-income and minority students and attempted to develop curriculum and instruction responding to needs of diverse learners.

AC English interns' approaches to teaching tended to be idiosyncratic and largely based on their own experiences as learners. The AC interns had difficulty evaluating their own instruction, and although highly creative, their strategies were often unresponsive to the needs of their learners.

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