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ABSTRACT

Between 1986 and 1990, a longitudinal study called Teacher Education and Learning to Teach (TELT) was conducted by the National Center for Research on Teacher Education (NCRTE). The purposes of the study were: to investigate how formal teacher education bears on teacher learning; the impact that a variety of approaches or alternatives have on teachers' knowledge and skills; and the role of teacher education in relation to the many other influences on teacher learning. This document describes the conceptual work involved in the TELT study, its general design, and some initial findings. Major findings are grouped according to several key issues in the area of teacher education and teacher learning: (1) learning subject matter knowledge and majoring in academic subjects in college; (2) learning to accommodate diverse learners; (3) learning with the help of mentors; (4) learning in alternative certification programs; and (5) learning in preservice teacher education programs that differ in structure and orientation. The TELT study suggests that substantial changes in teaching practice are most likely to occur when teachers have extended ongoing assistance that is grounded in classroom practice, providing opportunities to try and adapt new practices in their own classrooms and enabling teachers to learn concurrently about subject matter, how diverse students learn it, and how teachers can teach it. (Author/LL)

Special Report 6/91

Findings from the Teacher Education and Learning to Teach Study:

Final Report

The National Center for Research on Teacher Education

NCRTL

National Center for Research on Teacher Learning

Sponsored by the United States Department of Education
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FINDINGS FROM THE TEACHER EDUCATION AND LEARNING TO TEACH STUDY:

FINAL REPORT
THE NATIONAL CENTER FOR RESEARCH ON TEACHER EDUCATION

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National Center for Research on Teacher Learning

The National Center for Research on Teacher Learning (NCRTL)[1] was founded at Michigan State University in 1985 with a grant from the Office of Educational Research and Improvement, U.S. Department of Education.

The NCRTL is committed to research that will contribute to the improvement of teacher education and teacher learning. To further its mission, the NCRTL publishes research reports, issue papers, technical series, conference proceedings, and special reports on contemporary issues in teacher education. For more information about the NCRTL or to be placed on its mailing list, please write to the Editor, National Center for Research on Teacher Learning, 116 Erickson Hall, Michigan State University, East Lansing, Michigan 48824-1034.

Many papers published by the NCRTL are based on the Teacher Education and Learning to Teach Study (TELT), a single multisite longitudinal study. The researchers who have contributed to this study are listed below:

[1]Formerly known as the National Center for Research on Teacher Education (1985-1990), the Center was renamed in 1991.

6/92

Abstract

In looking at the question of how formal teacher education bears on teacher learning, the National Center for Research on Teacher Education (NCRTE) investigated (a) the impact that a variety of approaches or alternatives have on teachers' knowledge, skills, or dispositions, and (b) the role of formal teacher education in relation to the many other influences on teacher learning. Between 1986 and 1990, the NCRTE conducted a multisite, multiyear, longitudinal study of Teacher Education and Learning to Teach (TELT). This document describes the conceptual work involved in the TELT study, its general study design, and some of the initial findings. The major findings of this study are grouped according to several key issues in the area of teacher education and teacher learning: learning subject matter knowledge and majoring in academic subjects in college, learning to accommodate diverse learners, learning with the help of mentors, learning in alternative certification programs, and learning in preservice teacher education programs that differ in structure and orientation. The TELT study suggests that substantial changes in teaching practice are most likely to occur when teachers have extended, ongoing assistance (a) that is grounded in classroom practice, so that teachers have both opportunities to try and adapt new practices in their own classrooms and (b) that enables them to learn concurrently about subject matter, how diverse students learn it, and how teachers can teach it.

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Chapter 1

OVERVIEW OF THE STUDY[1]

The National Center for Research on Teacher Education (NCRTE) is looking squarely at the question of how formal teacher education bears on teacher learning. There are two ways of thinking about this question. One is to consider the question as one of impact—that is, what impact do various approaches or alternatives to teacher education have on teachers' knowledge, skills, or dispositions? The other is to consider teacher education as one of many influences on teachers and to examine its role in relation to those other influences. The Center is interested in both of these questions, especially as they relate to the teaching of two academic subjects—mathematics and writing.

These two questions have been at the heart of debate about teacher education since the first teacher institutes and normal schools were established more than a century ago. They have also been the focus of some research on teacher education. But there has been much more argument than inquiry, and often the issues have not been conceptualized in a way that would permit careful investigation. To contribute to these debates, the Center's work consists as much of conceptual development as it does gathering empirical data.

Our research strategy was developed so that these two activities would enhance one another. The conceptual work can improve the quality of the data we gather, and the data we gather can enhance our ability to clarify the concepts used to describe teacher education programs and teacher knowledge. Our goal has been to improve and expand both conceptual and empirical work in teacher education and teacher learning and, in so doing, to help focus debates about teacher education and inform teacher education policy and practice.

Between 1986 and 1990, the Center conducted a multisite, multiyear study of Teacher Education and Learning to Teach (TELT). The study enabled researchers to learn more about what actually happens in teacher education programs as well as to learn more about what teachers learn as they participate in these different programs. The purpose of this document is to describe the conceptual work involved in the TELT study, its general study design, and some of the initial findings from it.

Part I: The Study Design

One of the most difficult facts facing social scientists has been the realization that social phenomena cannot be disentangled in a way that permits unambiguous statements of causal relationships. Even when statistical relationships are strong, their interpretation is confused by multiple plausible causal chains and tempered by the fact that the observed relations may not generalize to other times in social history or to other social contexts. These difficulties have stimulated a number of methodological debates among researchers regarding the appropriateness of different research methods for different kinds of questions

[1] The NCRTE is housed at Michigan State University and sponsored by the United States Department of Education, Office of Educational Research and Improvement

and to a realization that we are moving into an era where "good" social science is plausible social science.

The Center's work is no exception. Teacher education programs are not independent variables that we can manipulate. They are formed by state governments, student bodies, and the demands of client school districts. Similarly, what students learn about teaching while participating in these programs depends on what they already learned elsewhere, on their ability to learn, on their beliefs about and dispositions toward teaching, on their inclination to learn, and on the nature of their concurrent learning experiences. We cannot control all of these influences. We cannot even measure them all.

To maximize the possibility of identifying plausible and meaningful relationships between opportunities to learn, on one hand, and changes in knowledge, skills, or dispositions, on the other, the Center's research design does three things. First, it focuses on two subjects—mathematics and writing—in the belief that the contrast between them will increase our understanding of the relationship between subject matter and teaching. Second, it includes a longitudinal study of teachers' knowledge, skill, and dispositions relevant to teaching mathematics and writing to diverse learners, so that we can see how these attributes change over time. Third, it includes a variety of approaches and alternatives to teacher education, in an effort to examine the different ways in which the tasks of teaching academic subjects to diverse learners may be handled. When combined, these strategies permit us to examine variations in opportunities to learn and in the sequence with which these opportunities are provided; and to examine variations in the kinds of knowledge, skills, or dispositions teachers acquire over time and under different circumstances.

Focusing on Mathematics and Writing

Our focus on mathematics and writing is based on a number of considerations. First, we wanted to select subjects that are taught throughout the K-12 curriculum so that the subjects would be important to teachers at all grade levels. Second, we wanted subjects which many students do not learn successfully in school. Third, we wanted subjects for which teaching to diverse learners has been shown to be problematic—where, for instance, curriculum issues such as tracking and stratification become relevant. Fourth, we wanted subjects for which there appeared to be a discrepancy between what research suggested were effective practices for teaching and what actual teaching practices tended to be.

Mathematics and writing meet all of these conditions. Both are taught throughout the K-12 curriculum, both are subjects with which students often have difficulty. Further, both are subjects for which students are often stratified, and in fact they are sometimes taught with different educational purpose to students of different perceived ability levels. For low-track students, these subjects may be taught as "tool" subjects, whereas for high-track students they may be taught as intellectual disciplines. Finally, both subjects have been the topic of considerable education research over the past decade, and mainstream school practices do not yet reflect the findings from this research. For all of these reasons, then, teacher preparation to teach these subjects to diverse learners seems to us to be an important and worthwhile topic for investigation.

Longitudinal Study of Teacher Learning

The second important feature of the Teacher Education and Learning to Teach Study consists of longitudinal studies of teacher learning. Within each participating site, we followed a sample of teacher candidates over time, gauging their knowledge, skills and dispositions several times as they progressed through these programs or through their teaching careers.

To track changes in program participants, we visited teachers and teacher candidates on repeated occasions, asking them roughly the same set of questions each time. The first visit occurred at the beginning of the program, the last after the teachers had completed their programs and had been teaching on their own for several months. The number of visits in between these two points depended on the nature and schedule of the program.

Because there has been so little research of this type, the Center's data has the potential to contribute to a remarkable array of contemporary policy issues. For instance, our design permits us to test the claim that teacher candidates do not learn much while participating in teacher education programs, for we can describe what candidates think prior to program participation and contrast that with what they think at the close of their programs. In a few cases, we can also contrast teacher education candidates with other students who are enrolled in liberal arts programs. The design also permits us to contrast elementary teacher candidates with secondary teacher candidates, thereby testing prevailing hypotheses about differences in subject matter knowledge among these groups. And we can contrast first-year teachers participating in induction programs with those entering teaching through alternate routes and see how these introductions to teaching have different influences on new teachers.

Each such contrast would constitute a major step forward in our understanding about the role of teacher education in teacher learning. Yet if the Center pursued all of these contrasts, its resources would be spread so thinly that the quality of our knowledge about teacher learning would be compromised. Indeed, there are far more opportunities than the Center has resources to take advantage of. The findings described in this document are necessarily preliminary and do not reflect the full potential of our data base.

Variety of Approaches and Alternatives to Teacher Education

The research questions we were interested in required us to examine diverse approaches and alternatives to teacher education. We wanted our sample to include both the important ideas in contemporary teacher education and the main kinds of learning opportunities currently being provided. Since our eventual sample would include only 11 programs, we could not select these cases probabilistically, for a probability sample of contemporary approaches to teacher education would not necessarily include the particular kinds of examples we wished to investigate. An optimal sample—one that includes the important ideas in teacher education—would not represent a natural distribution of teacher education approaches and alternatives, nor would it reflect intermittent points along a single continuum of approaches. We therefore used a purposive sampling strategy, and organized

our search for cases around the kinds of ideas and learning opportunities they presented. Table 1 summarizes the programs we eventually selected.

Part II: Designing The Study

Selecting Programs to Study

Three criteria were particularly important in our sampling decisions: the stages of teacher development represented by the program, the relationship portrayed by the program between subject matter and pedagogy, and the models of knowledge implied in the programs.

Stages of teacher development. Because the Center is interested in teacher development, we wanted to study approaches that differed in the stage of teacher development to which they attend. For our purposes, stages of development can be roughly divided into three categories: pre-teaching, early teaching, and experienced teaching. Contemporary approaches to teacher education address these three stages in rather different ways and carry different titles as well. Traditional preservice programs, for instance, address the unique problems of prospective teachers—people who intend to teach, but have never actually tried it. Two other approaches, alternative routes to teaching and induction programs, are designed to facilitate the first year(s) of teaching. Finally, inservice programs are designed to help teachers who have been practicing for varying amounts of time. These differences are important to the Center's research agenda: To the extent that different programs emphasize different kinds of knowledge or provide different kinds of learning opportunities, their differences may reflect implicit—and untested—theories of teacher development. We therefore wanted each of these types of opportunities included in our sample. The distribution we obtained on this dimension is as follows:

Preservice programs

- The Elementary Education and Secondary Mathematics Education Programs at Illinois State University represent a longstanding and still popular tradition in undergraduate teacher education in this country. The program at ISU developed out of a normal school and continues to prepare large numbers of teachers each year.

- The Early Childhood and Elementary Program at Norfolk State University—a traditionally black college—has an open enrollment policy and serves a substantial proportion of minority candidates.

- At the University of Florida, the secondary PROTEACH Program, a fifth-year program, emphasizing both reflective teaching and teacher effectiveness research.

Table 1
Description of the Teacher Education Programs included in the TELT Sample

Program	Conception of Knowledge for Teaching	Conception of Pedagogy	Structure	Setting	Direction of Change
Preservice					
PROTEACH, Univ. of Florida	Scientific	Not clear	Elem: 5 year Sec: BA + 5th yr.	Large state research university	Reflective teaching
Academic Learning, Michigan State Univ.	Not clear	Subject-specific	4 years; mentors; 3-course math sequence	Large state research university	Teaching diverse learners
Teacher Education, Dartmouth College	Liberal	Not clear	4 years	Small, elite liberal arts college	Not clear
Teacher Education, Illinois State Univ.	Not clear	Generic	4 years; methods blocks	Large state university (former teachers' college)	State-mandated limits on ed credits
Teacher Education, Norfolk State Univ.	Scientific	Generic	4 years	Historically black , urban institution	State-mandated teacher test
Alternate Route					
Provisional Teacher Program, New Jersey	Skill/Craft	Generic	Summer classes; weekend sessions	State department of education	Not clear
Teacher Training Program, LAUSD	Skill/Craft	Generic	Summer; mentors; multicultural week	Large urban school district	Not clear
Induction					
Graduate Intern/Teacher Induction, U NM-Albuquerque Schools	Not clear	Not clear	Classes for MA; visits from & seminars with Clinical Teachers	Urban school district-state university collaboration	More attention to knowledge of subject
Staff Development					
SummerMath, Mt. Holyoke	Not clear	Subject-specific	Summer institute; classroom follow-up	Summer program at a liberal arts college	More attention to knowledge of subject
Teachers College Writing Project	Skill/Craft	Subject-specific	Summer institute; support in classrooms	Urban university-school district cooperation	Not clear

- Also at the University of Florida, the elementary PROTEACH program, a five-year program designed to accomplish similar goals as its secondary counterpart.

- The Teacher Education Program at Dartmouth College is an undergraduate program offered by a highly selective private liberal arts college and emphasizes liberal arts education more than professional education.

- The Academic Learning Program at Michigan State University, a four-year undergraduate program designed to improve candidates' understanding of the subject matter they will be teaching.

First-year programs

- The Teacher Trainee Program in the Los Angeles Unified School District provides an alternative route to secondary teaching certification for people with a bachelor's degree in the subject they will teach and who can pass a general skills and subject matter test. Run by the school district, the program is geared to inner-city teaching.

- The New Jersey Provisional Teacher Program, sponsored by the state of New Jersey, provides on-the-job training to liberal arts graduates who are offered either elementary or secondary teaching positions and who can pass the NTE.

- The Graduate Intern/Teacher Induction Program is a collaborative program between the University of New Mexico and the Albuquerque Public Schools for graduates of a preservice program.

Inservice programs

- The SummerMath for Teachers Project at Mt. Holyoke College provides a summer institute and classroom follow-up to teachers during the school year.

- The Teachers College Writing Project works to change schools by providing in-class training to groups of teachers in the same schools and encouraging them to form professional networks of their own.

Relationship between pedagogy and subject matter. Because of the Center's interest in teaching academic subjects, we wanted our sample to reflect the main ideas regarding the relationship between pedagogy and subject matter. There are two prominent views. One holds that pedagogical skills are generic—that the same pedagogical skills apply equally well

across all subjects. The other view holds that pedagogy varies across subject matter and is determined by the nature of the subject. There are many views in between these extremes. Because a major goal of the Center is to determine more precisely the nature of these different views, and the ways in which these views become exemplified in teacher education programs, we wanted to include in our sample programs that exemplified different views on this important matter. Though it was not possible to know the nuances of program views prior to beginning the study, we were able to assure that at least some of the programs we studied fell into the two general camps, as follows:

Programs that present pedagogy as generic

Norfolk State University
Illinois State University
New Jersey Alternative Route
Los Angeles Alternative Route

Programs that present pedagogy in the context of subject matter

Michigan State University
Teachers College Writing Project
Mt. Holyoke SummerMath Program

Models of knowledge. Because many of our research questions have to do with program purposes, we want to study approaches and alternatives that vary in their views about the kinds of knowledge that are relevant to teaching and how these are fostered. One way to think about this is to identify different topics that may be provided—subject matter, child development, or teaching theories, for instance. Another is to focus on qualitative differences among kinds of knowledge—programs may differ in their attention to knowledge, skills, and dispositions, for instance. Yet another is to focus on the way in which programs think knowledge will be useful to practice.

On the basis of our literature reviews and the findings from our exploratory site visits, we realize that these different ways of viewing knowledge may be interrelated, and that they form models of knowledge. Each model includes a view of what knowledge is, how it is acquired, and how it is used. The most prevalent model we saw in preservice teacher education programs is a scientific one: Knowledge consists of theory and empirical research findings that can be imparted to students through formal courses and can be applied in practice. But another important model that appears in both preservice and alternative route programs is the liberal arts model. It holds that knowledge is enriching or liberating and that exposure to the thinking of different disciplines can expand the individual's intellectual powers. This kind of knowledge influences practice, but it is not prescriptive in the sense that theory and empirical research findings are. A third model holds that teaching knowledge is primarily craft or skill. It is acquired through experience or through guidance from experienced peers.

Each of these models of teacher knowledge imply particular ways in which knowledge is transmitted and different ways in which it is "used" in practice. Our sample includes sites which exemplify each of these kinds of teacher knowledge. Though we could not know the views of every program we considered, we could assure that our study included at least one example of each of the three main models of knowledge. Their distribution is as follows:

Liberal knowledge

Dartmouth College

Scientific knowledge

Norfolk State University
University of Florida PROTEACH

Skill/Craft knowledge

Teachers College Writing Project
Los Angeles Alternative Route
New Jersey Alternative Route

There are many other important variations among approaches to teacher education. Some of these have not played an important role in our sample selection because they were not directly related to our research questions. Others are important to our work but still defy definition. An example of the latter is the concept of program coherence. We feel this idea is an important one, and one on which we would like our sample of programs to vary, but the concept has proved to be too slippery to define. Programs may be carefully organized but theoretically inconsistent; they may be thematically consistent but substantively eclectic; they may be coherent from the faculty's point of view but not from the students; or some portions may be coherent while others are not. Further, some forms of program coherence may be beneficial while others may verge on ideology and detract from program quality. Rather than forcing distinctions that may prove invalid later on, we chose to allow our sites to vary naturally on this dimension, and we adopted a long-term goal of defining the many meanings of coherence and their implications for teacher education.

Another important way in which our programs vary is in the type of institutions in which they reside. Our preservice programs are housed in highly selective colleges and in open-enrollment colleges, in large public universities and in smaller private colleges, in institutions that have evolved from a normal school and in those that grew from other roots. One of our two alternative route programs is sponsored by a state, the other by a school district. And one of our inservice programs works within a school district and encourages groups of teachers within schools to work together in their learning, while the other serves teachers individually from a wide array of districts.

Another important way in which our sites vary is in the type and duration of field experiences they provide. Though it would be possible to array them according to, say, the total time devoted to field experiences, we are more interested in the purpose and character of these experiences than we are in their duration. Further, even with full knowledge of purposes for field experiences, we would need deeper knowledge about the way students actually experience their field work before we could define the real character of these experiences. While such an examination would be possible after the study was completed, it was not possible at the time programs were being selected for study.

Instead of trying to array our programs on dimensions that we still did not understand, we allowed them to vary naturally on these dimensions. Because these programs differed on so many dimensions, and because several of these dimensions were relevant to our study, site selection proved to be difficult. Every program offered a unique research opportunity, and every pair of programs offered unique contrasts. The selection process, therefore, did not rest on which sites were "best" in some absolute sense, but instead on which pattern of sites offered the maximum potential for addressing a package of research questions. Through a complicated process of trying alternative combinations and reviewing each combination's potential, we settled on the sites described here.

Designing Case Studies of Programs

Our studies of these programs had to be designed to accomplish two disparate goals. On one hand, they had to be tailored to fit the circumstances of the particular site. On the other, they had to produce data that would be comparable across sites. We accomplished these two goals by (a) identifying central program components within each program, recognizing that these may vary from site to site; (b) identifying major sources of data within each component, also allowing for variation across sites; and (c) identifying a common set of variables to be examined through each source of data in each program component in each site.

We selected the following program components for study in preservice teacher education:

- a course that covers learning or child development;
- a course that covers methods for teaching mathematics;
- a course that covers methods for teaching writing;
- student teaching;
- a mathematics course offered by the mathematics department; and
- a writing course offered by the English department.

When preservice programs did not offer these components, and when they identify other program components as more central than these, our list of components is altered accordingly.

We also wanted to contrast teacher education courses with arts and sciences courses. The arts and sciences components we select for examination in each site include:

- an upper-level mathematics course not specifically for teachers;
- an upper-level writing course not specifically for teachers; and
- a humanities or science course required of all students.

With respect to induction programs, inservice programs and alternative routes, the primary components to be studied include the following:

- multiweek summer workshops;
- seminars held during the evenings concurrent with teaching experiences;
- classroom experiences; and
- consultations between teachers and mentors or other supervisors of classroom teaching.

When programs identified components other than these, and when they did not offer these particular components, we altered our list of components accordingly.

To learn about these program components, we developed several data collection systems. First, we developed a questionnaire that could be administered to all participating faculty or staff trainers. Two forms exist, one designed for preservice faculty and one for workshop trainers or others working with teachers in the field. Second, we developed an interview guide, with separate forms for faculty teaching various subjects under varying circumstances. The interview guide is used with any faculty trainers or mentors teaching the components listed above. Third, we developed a guide for observing university courses and another for observing guided practice sessions. These guides are also used for studying the principal components listed above. Finally, we gathered numerous documents while visiting each program—course syllabi, examinations, program descriptions, copies of policies regarding requirements, and so forth.

All of these data sources—our surveys, observations, interviews, and documents—reveal information about the learning opportunities provided to teachers or prospective teachers and the kinds of intellectual demands made of them. The variables we examine through these sources are:

- the program components, their organization and sequence, and the rationale for them;
- contextual influences on the components and their organization;
- program ethos, defined as the implicit messages given to teacher candidates about subject matter, teaching, learning, student diversity, and schools;
- standards for entry into or exit from the program and standards of conduct throughout the program;
- the backgrounds, beliefs, and work of the teacher educators;

- the details of particular components—their content, rationale, standards; the nature of learning opportunities provided, both in terms of academic discourse and in terms of the kinds of expertise fostered; and how the content is related to the practice of teaching.

We do not necessarily learn about each variable through each source of data. However, across sources, we have gathered enough information to portray each program according to these variables. By observing formal courses or interactions with mentors or supervisors, we learn what topics are covered and the forms and sources of knowledge under discussion; by interviewing faculty or inservice staff we learn how faculty see these as related to teaching; by analyzing assignments and examinations, we assess the standards to which candidates are held accountable.

Designing the Data Collection Instruments

The Center's most difficult task was to design a set of data collection instruments that could be used to track teacher learning over time. Several important questions needed to be addressed:

1. What aspects of teaching should we study?
2. What aspects of teacher expertise should we document, and how can we document these things?
3. Where and how should we seek evidence of connections between knowledge to practice?
4. What kind of teaching tasks are valid representations of teaching?
5. What criteria should we use to sample teachers' subject matter knowledge?
6. How should we pose questions about learner diversity?

Answering these questions entailed much more than simply choosing among available alternatives. No clear alternatives were available. Our task, therefore, was to choose an aspect of teaching on which we would focus, develop a conceptually defensible model of the knowledge, skills, or dispositions that contributed to that aspect of teaching, and a develop a framework for data collection instruments that would tap the kind of knowledge or skills we had earlier identified. The data collection instruments we devised, therefore, are more than merely a collection of interesting questions one can ask teachers. They are the product of a tremendous amount of thinking that warrants examination even apart from the particular data collection devices it ultimately yielded. Below we discuss our thinking on each of the central questions listed above.

1. What aspects of teaching should we study? There are many ways of construing the phenomenon we call "teaching." Some people envision teachers as representatives of academic disciplines and assume their primary influence on students derives from their enthusiasm and knowledge of their subjects. Others think of teachers largely as alternative parents and assume their primary influence on students derives from their moral character

and the type of role model they present. Still others envision teachers as members of the larger community, thinking that their influence on students comes not merely from what occurs within schools but from what occurs when teachers meet with parents in homes, at church, or on other occasions. Still others envision teachers as bureaucrats, implementing district curricula and managing students as they proceed through their lessons, so that their primary influence on students derives from their ability to efficiently manage classroom activities. Finally, many envision teachers as professionals who work with colleagues in the development of curricula, school programs and policies.

Each of these aspects of teaching contains some truth, yet each is too narrow to adequately represent teaching, for teaching can be all of these things. Still, a research project such as we set out to do cannot possibly measure the full range of teacher knowledge, skills, or dispositions relevant to all of these aspects of teaching. We clearly needed to take a position on the phenomenon of "teaching."

We did not adopt any of the perspectives described above, but instead fashioned our own. We wanted to recognize two important points: first, whatever responsibilities teachers may have in their communities or in their schools, the bulk of their responsibilities occur within their own classrooms. Thus, the most critical aspects of teaching must reside there. Second, we recognize that the phenomenon of teaching entails both subject matter and students and that any description that recognizes only one of these cannot adequately portray teaching. We therefore focused our investigation on teaching academic subjects to diverse learners. In so doing, we implicitly chose not to gather data on teachers' knowledge about or skill in talking with parents, negotiating with administrators, working on school committees or with PTA associations, or even managing classrooms.

Choosing to concentrate on this aspect of teaching enabled us at once to delimit the scope of our study considerably while still leaving it open enough to capture the range of things teachers might be learning in the diverse programs we studied. But even this focus left too broad a range of things we could investigate. There are many school subjects, for instance, and teachers may need to know different things about each. And teachers need to be prepared to teach many kinds and combinations of learners. It might be possible to limit the study to one subject so that we would study, say, learning to teach mathematics, or learning to teach history, but such an approach would not allow us to see whether different subjects placed different demands on teachers. It seemed important to include at least two subjects, so that the differences between them could be examined. It also seemed important not to include more than two, in the interest of narrowing the study's scope.

It did not make sense to follow a similar route for examining what teachers learn about diverse learners; that is, it did not make sense to focus the study on two particular kinds of learners. But it did seem to us that some issues regarding diverse learners were more salient than others. One such issue was diversity per se; that is, what do teachers know or learn about how to handle heterogeneity within their own classrooms? While it may be true that particular kinds of learners make particular demands of teachers, it is also true that virtually every teacher must respond simultaneously to many kinds of students. Male and female, quick and slow, quiet and noisy, theistic and atheistic, all reside within each classroom. The second important issue on the learner side of the equation is the treatment of particular groups of students who have traditionally not been well served by

our schools—poor children and children of color. Given the changing demographic makeup of our student populations, and the nonchanging demographic makeup of our teaching population, this issue of student diversity seemed important to address.

Thus, when the TELT study defines its focus on learning to teach academic subjects to diverse learners, it refers specifically to mathematics and writing, and it refers specifically to teaching these subjects in heterogeneous classrooms and/or to traditionally less-well served populations of students. Having established all of this, we may now ask, what should we expect teachers to be learning that will enable them to accomplish these tasks?

2. What aspects of teacher expertise should we document, and how can we document these things? Just as there have always been different perspectives on the nature of teaching, there have always been different perspectives on what contributes to good teaching. One perspective emphasizes the knowledge demands, another the skill demands. Still others emphasize dispositions, beliefs, or values. The problem of defining teacher expertise was not simplified by defining one aspect of teaching to focus on. For teachers have not only knowledge about their subject and their students; they also have attitudes toward both, and skills related to teaching particular subjects to particular students. Though teaching has been the subject of attention by scholars for centuries, there is very little empirical knowledge about the relative contributions of these different aspects of expertise to teaching. All seem equally important.

Yet recognizing all of these introduces an unusual sort of data collection problem, for each aspect of expertise requires its own method of documentation. We can learn about teachers' skills by observing their teaching, for instance, but cannot very well learn what they know or believe. In contrast, if we used paper-and-pencil instruments to measure teachers' knowledge and beliefs, how could we know whether these bits of knowledge or beliefs had any bearing on practice? If we were to be true to our understanding of teaching as influenced by all of these things—knowledge, skills, dispositions, beliefs, et cetera, then we needed a method of data collection that could tap all of these things. We could not limit data collection to one format.

The data collection system ultimately developed for the TELT study entailed three major data-collection formats. One, a questionnaire, was limited to multiple-choice questions and questions asking for degree of agreement on Lickert scales. The questionnaire allowed us to gather data on knowledge, attitudes, and beliefs and to gather these data in a standardized way from all study participants. Our second instrument, an observation guide, was used whenever teachers were in classrooms as student teachers, as novices in alternative routes or induction programs, or as experienced teachers. The observation guide enables us to document actual teaching practices. The observation guide is accompanied by pre- and post-observation interviews that enabled us to learn the teachers' reasons for the practices we observed. Although we provided our observers with guidelines for observing and documenting their observations, and standardized questions for the pre- and post-observation interviews, the contents of these observations were necessarily variable, for we could not control what a teacher happened to be teaching on the particular day we visited.

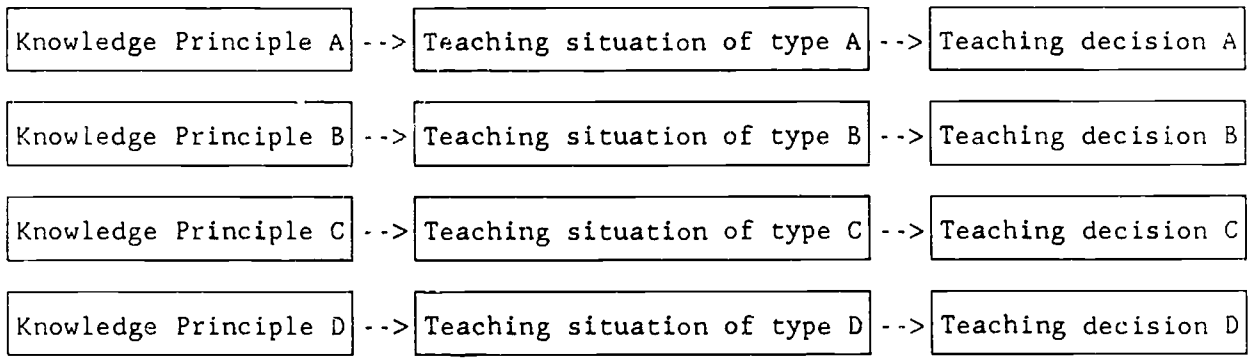
Finally, we devised an interview. The interview provided teachers with hypothetical teaching situations and asked them how they would respond to these. Since the situations

were standardized, the interview had some of the advantages of the questionnaire. Since the responses were open-ended, though, it also had some of the advantages of the observation guide. Moreover, since the interview couched virtually all its questions in the context of teaching situations, it offered an opportunity to see how the various aspects of expertise—knowledge, beliefs, attitudes—about teaching, learning, and subject matter, were drawn on to make teaching decisions.

Each of these three instruments was designed to address the focal points of our study: The questionnaire and interview are organized around the two main subjects, mathematics and writing, and each contains questions designed specifically to learn what teachers think about student heterogeneity and about students from particular cultural backgrounds. The observation guide encourages researchers to observe the teaching of one or both of these two subjects, and to take special note of how teacher attend to different students in the classroom—to note, for instance, whether children get called on at random and whether there seems to be a pattern.

Since the interview posed a special burden, in that it represents an attempt to learn about the connections between various aspects of expertise and particular teaching decisions, we devote a special section to it here.

3. Where and how should we seek evidence of connections between expertise and practice? One of the most difficult tasks for researchers of teacher knowledge and teacher learning has been developing a reasonable portrayal of the relationship between (a) knowledge about various aspects of teaching and (b) decisions about teaching in particular situations. At one extreme are those who expect teachers to apply specific rules, or research findings, directly to their teaching practices. Such a model sees teaching decisions following directly from a formally derived knowledge base. It might be portrayed as follows:

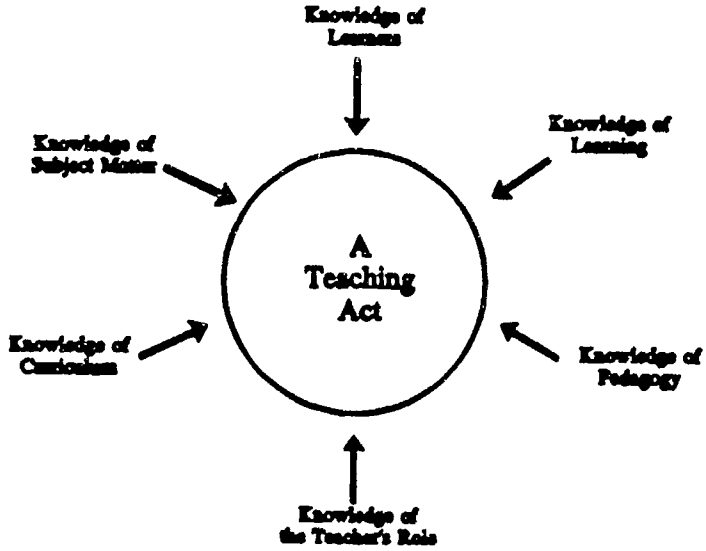


and so forth.

Critics of this model point out that it allows teachers few degrees of freedom, and that real decisions depend on the particular student(s) involved, the time of the year, the subject, and so forth. Indeed, at the other extreme is the view that teaching is so situation-specific that teachers cannot possibly benefit from any generalizable propositions. Under this view, there is no defensible content for teacher education, no purpose for research on teaching, no justifiable content on which teachers can be assessed for purposes of licensing or promoting them. Instead, teacher knowledge must necessarily evolve idiosyncratically,

as each teacher learns to "read" instructional situations and develops a set of ad-hoc methods for responding to them.

Neither of these views seemed adequate. What we wanted was a way to recognize that teaching decisions are context-sensitive, but that they also are based on broader principles. Instead of either of the two models described above, we envisioned a form of teaching where teaching decisions were informed by broader principles and beliefs and that these broader principles represented a variety of domains, as follows:



Though this diagram highlights the various content domains of teacher expertise, we should point out that teachers may hold several forms of expertise (knowledge, values, disposition skills, etc.) in each domain. A teacher may know a great deal about a subject but dislike it, may know very little about students from a particular cultural background but have strong commitments to assuring that all students learn. Teachers may have strong values regarding their own role as teachers, perceiving themselves to be authority figures, or mentors, or guides. The point is that teachers draw on all of these aspects of expertise as well as on all these domains of knowledge when they make decisions about how to handle various teaching situations.

This model of teaching expertise, and of how it contributes to teaching practice, has a number of conceptual advantages over either of the first two models for research on teacher learning. In comparison to the first model, for instance, this model recognizes that teaching situations are multidimensional and rarely governed by a single principle. Second, it recognizes that teachers will make instructional decisions, regardless of what knowledge or beliefs they have available to them; that is, if they know little about the curriculum but a lot about the learning, they will probably base their decision on their understanding of learning. If they know a lot about the subject matter but little about the learners, they will probably base their decision on the subject. Or if they perceive learners to be more

important than subject matter, regardless of what they know about each, they may base their decision on what they understand about learners. This model, then, recognizes that virtually every decision will be based on an interaction among many ideas.

In contrast, in comparison to the second model, this model does not abandon the notion that there are relevant bodies of knowledge and values on which teachers should depend. To suggest that teachers draw on particular knowledge, beliefs, or dispositions does suggest that there is something there that can be drawn on. Moreover, this model enables us to define the range of substantive ideas that we might expect to influence teaching decision, and to trace the extent of each influence. For instance, if we ask a teacher how she might handle a particular teaching situation, and why, we can dissect her answer to see whether and how subject matter considerations influenced her decision, whether and how learner diversity influenced her answer, and so on. In this way, we hope our research can not only contribute to knowledge about how teachers learn, but also to knowledge about how they make pedagogical decisions.

But the model still leaves open the question of how one documents teacher expertise, and in particular how one documents changes in teacher knowledge, beliefs, and values, using such a model. Our strategy was to present standardized situations to our teachers and teacher candidates, asking them on repeated occasions to tell us how they would handle these situations and why. We take changes in their responses over time to reflect things they have learned during the intervals. The next questions we had to address, then, was what kinds of teaching situations we should pose, and what particular substantive issues we should incorporate into these situations.

4. What kinds of teaching tasks are valid representations of teaching? Ever since Charters and Waples's study in the 1930s, researchers and teacher educators have tried to define teachers' work in a way that could contribute to a curriculum for teacher education. There are many ways in which such efforts can go awry. Teaching tasks can become so numerous and so fine-grained that they lose face validity; they can be defined as if they existed independent of each other or of any teaching purpose, and they can be defined, with no connection to knowledge, beliefs or values. Though our interest was not in contributing to a teacher education curriculum, it was no less daunting, for we wanted the hypothetical situations we posed in our interview to be (a) relevant to teaching academic subjects to diverse learners, (b) representative of the kind of real situations teachers must face, and (c) structured in a way that would enable us to dissect the variety of ideas that contributed to our respondents' instructional decisions.

At a relatively broad level, the problems and tasks we presented to our teachers and teacher candidates do build on some of the commonly used categories of teacher work. We ask them to evaluate some student work, for instance, and to evaluate some textbook selections. We ask them to plan a lesson, given a particular classroom situation. But since our interest is in their particular ability to do these things when teaching mathematics or writing to diverse learners, we do not, for instance, examine their ability to prepare a lesson plan that conforms to any particular idealized model of a lesson plan. Instead, we ask what they would do with a particular substantive issue and a particular student body and why, and we examine their responses to see how considerations of subject matter, curriculum and learners contribute to their decisions.

The teaching tasks we eventually defined are as follows:

- Responding to student difficulties with a particular concept
- Responding to student novel ideas regarding a particular concept
- Generating representations of concepts
- Helping students get started writing
- Responding to student questions
- Helping students learn concepts and procedures
- Planning a unit
- Evaluating student work

All of these tasks, we believe, are relevant to teaching mathematics and/or writing to diverse learners. Moreover, all of them are tasks which all teachers must be able to do. Virtually every teacher will face situations in which students do not understand a particular concept, unit, or lesson, and the teacher must decide what to do next. Virtually every teacher will face situations in which students invent their own solutions to problems, and the teacher must find a way to respond to these novel ideas. And so forth. These tasks, then, are intuitively correct; they have a high face validity.

In the hypothetical scenarios we developed around these tasks, we endeavored to generate situations in which the teacher would need to take into account both subject matter and learners, though the particular aspects of subject matter and learners which we drew on varied from situation to situation. This decision to particularize teaching tasks--to place them in particular contexts--introduced two other questions: First, what substantive content should be draw on when creating a subject matter context, and second, how can we portray the context of learners without biasing the responses?

5. What criteria should we use to sample teachers' subject matter knowledge? Although one of our interests is in teachers' knowledge of the subjects of mathematics and writing, we were not in a position to develop thorough, complete portraits of teachers' subject matter knowledge. Such portraits were beyond the scope of our research agenda and inappropriate to our purposes for several reasons. First, we did not wish to present ourselves as examiners to our study participants. We had, after all, already argued that we expected teachers to change in a number of different directions and that our interest was not in judging the correctness of these changes but rather in trying to find connections between the nature of these changes and the kind of experiences they had encountered as they were learning to teach. It would seem inconsistent to suddenly require them to succumb to an examination of their subject matter knowledge. Second, we had come to believe that teaching decisions might be as influenced by teachers' beliefs about particular subjects and attitudes toward subjects as by their knowledge of these subjects. Thus it was not clear to us the extent to which we wanted to concentrate our effort on subject matter knowledge per se.

Yet, on the other hand, how could we say anything reasonable or valid about subject matter knowledge without a full examination? Our solution to this dilemma was to identify, within each of our subjects, a limited set of substantive concepts that met a number of criteria. First, we wanted substance that was central to the curriculum, and that appeared

Table 2

Subject Matter Contexts Selected for Each Teaching Task

Teaching Tasks	Mathematical Idea	Aspect of Writing
Responding to student difficulties with a particular concept	Place Value	Representing possession Use of Apostrophes
Responding to student novel ideas regarding a particular concept	Relationship between perimeter and area, nature of mathematical proof	Representing quoted material (elementary); story structure, citing sources (secondary)
Generating representations of concepts	Division, fractions	
Helping students get started writing		Autobiography
Responding to student questions	Division, zero (secondary only)	Source of language conventions, pronoun/verb agreement
Helping students learn concepts and procedures	Solving equations (Secondary only)	
Planning a unit	Subtraction with regrouping (elementary); Slope (secondary)	Planning organizing for writing
Evaluating student work	Subtraction with regrouping (elementary); Slope (secondary)	Essay structure

throughout the entire K-12 curriculum; that is, we wanted content that virtually all teachers would have to attend to. Second, we wanted concepts that were known to give students difficulty; that is, that were difficult to teach. Third, we wanted substantive ideas that were considered either central or very important to the discipline. In sum, even though we recognized that we could not tap the full breadth of teacher knowledge, even within these two subjects, we did want to assure that the subject matter knowledge we examined was relevant to the discipline and relevant to teaching it.

Table 2 shows the substantive ideas we chose as contexts for each of the hypothetical situations we presented to our respondents. In the next section, we discuss the problem of examining teachers ideas about learner diversity.

6. How should we pose questions about learner diversity? Research on teacher knowledge and beliefs about student diversity is difficult for a number of reasons. First, there is little agreement in the field as to what teachers should know or believe. In one respect, the variety of viewpoints benefits our research, for it enables us to see whether programs which differ in their approach to this issue yield differences in teachers. In another respect, this same variety introduces problems in terms of what we should be looking for, and in terms of what constitutes evidence of a particular view.

Second, this topic is one in which we can expect teachers to have gathered numerous views from a number of places aside from formal teacher education programs. Moreover, we probably could expect these various views to be as influential or more influential than formal knowledge per se might be. Third, the subject of learner diversity has received so much public attention over the past two decades that teachers and teacher candidates are highly likely to realize that certain viewpoints are more socially acceptable than others. Thus there is more chance that their espoused views might differ from their real views. Moreover, it is not clear how teachers' views in this area might affect their practice. What they say on questionnaires and in interviews may have little to do with how they behave in real classroom situations. The following figure shows the relationship between our three data collection intruments.

Selecting Longitudinal Samples

Because our data collection instruments require different levels of effort from respondents, we devised a sampling strategy that would, on one hand, maximize the sample size, while on the other hand, delimit the labor costs of data collection. We were able to administer this questionnaire to a broad sample of teachers and teacher candidates within each site. We refer to these groups as our extensive samples. Extensive samples often included the entire population of teacher candidates. Across the entire study, over 700 teachers and teacher candidates responded to the questionnaire. The other data collection strategies—interviews and classroom observations—were used on carefully-constructed intensive samples. Below we describe each of these samples and our associated sampling strategies.

Extensive samples. In preservice sites, extensive samples include the following categories of students:

- elementary teacher-education candidates;
- secondary mathematics teacher-education candidates;
- secondary English teacher-education candidates;
- mathematics majors;
- English majors; and
- (in some sites) arts and science students studying other disciplines.

Inclusion of these categories of students in the sample enables us to identify differences across groups—such as teacher-education majors versus arts and sciences majors—in their views about teaching and in their knowledge and understanding of certain aspects of teaching.

Intensive samples. The intensive samples include only about 12 teacher candidates from each site. Because the intensive samples are smaller, we carefully orchestrated our choice of these candidates to maximize the number and kind of research questions that could be addressed with these samples. For instance, we interviewed math majors only in sites where we were also interviewing secondary mathematics candidates. Because of contemporary concern about the subject-matter competence of elementary teachers, we include elementary teacher candidates in a more diverse array of sites. Table 3 shows the location of our intensive samples. Across the entire study, over 160 teachers or teacher candidates participated in the interviews and observations.

Data Collection Schedule

The schedule for data collection varied among sites. Those offering two- or three-year programs were studied with an elongated data collection schedule. Those providing condensed programs, on the other hand, were studied with condensed data collection schedules.

The lengthier programs tended to be preservice programs. These programs often provide courses to students as early as their freshman or sophomore years, though most do not begin serious professional education until the junior year. In most of these programs, we began our longitudinal study at the beginning of the junior year and followed them through to their first year of independent teaching.

There are many exceptions to this general pattern. Dartmouth, for instance, provides its teacher education courses entirely during the senior year, so we were able to conduct one-year longitudinal studies of two consecutive cohorts of students. Florida's secondary program is essentially a fifth-year program; our study there began with fifth-year students rather than juniors. On the other hand, Florida's elementary program is a five-year program which concentrates on the last three years. Consequently we began our longitudinal study of elementary candidates in Florida at the beginning of their third year, and followed them through the three years of their program.

Data Collection Design: Teacher Education & Learning to Teach Study (Learner Data Only)

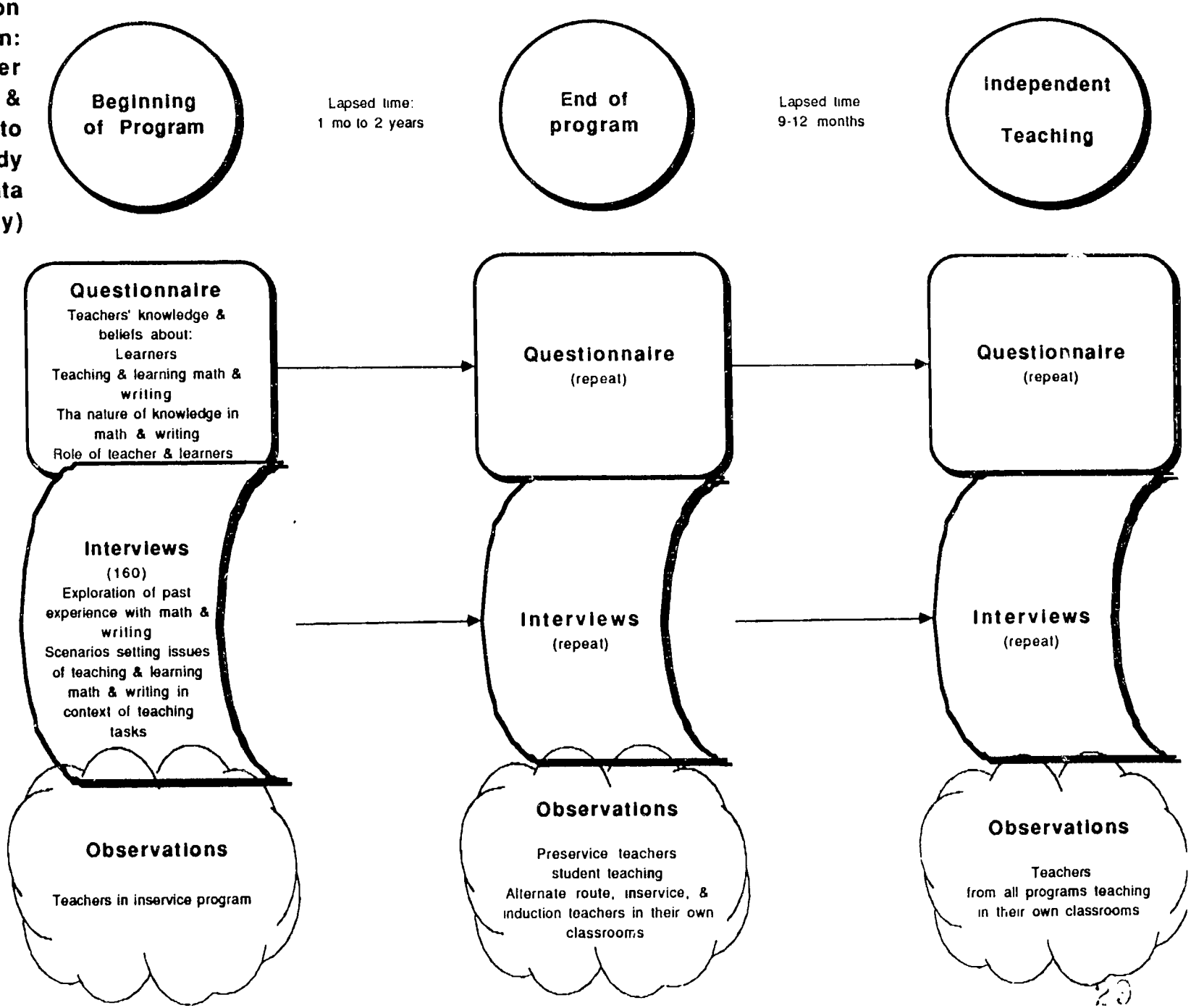


Table 3

Location of Intensive Samples

	Elementary	Sec. Math	Sec. English	Math Major	English Major	Others
Preservice						
MSU	X	X		X		
ISU	X	X		X		
FL	X		X		X	X
Norfolk	X					
Dartmouth	X	X	X			X
First Year						
Albuquerque	X					
LA		X	X	X	X	
NJ	X					
Experienced Teachers						
TC	X					
Mt. Holyoke	X					

The condensed programs tended to serve practicing teachers. Two are inservice programs, one is an alternative route to certification, and one is an induction program. In three of these sites, (one in-service and two first-year program sites) a great deal of teacher education occurs daily as teachers are teaching. To be sure that we were able to detect the changes that may be occurring among these teachers, we designed our longitudinal study to include three visits during the first year of inservice training in these sites.

CHAPTER 2

LEARNING TO TEACH MATHEMATICS

Mathematics teaching is currently the object of public consternation and debate. Proposals abound to reform mathematics teaching and improve outcomes. In the last decade, much research has also focused on student learning in mathematics, on mathematics teaching, and on mathematics curriculum. Many students, particularly minority and poor students, are being failed by current approaches to mathematics education. Although agreement exists that changes are needed, what such changes would look like and entail varies considerably. For some, using manipulatives is the ticket to improved mathematics teaching; others argue for increased student discussion and engagement in complex problems. Differences arise over the role that the teacher should play—as facilitator of students' constructions or as a clear presenter of ideas and procedures using models and examples designed to engage students and make mathematics meaningful. Teacher education could be seen as one lever to alter the practice of K-12 mathematics teaching, drawing on both research and reform. We were interested in how teacher educators might attempt to prepare teachers who could teach mathematics well—and what "teaching well" might mean in different programs. We were also interested in how teachers and prospective teachers might react to information, ideas, and experiences related to new ideas about mathematics teaching. How might they, steeped in traditional views of mathematics and mathematics teaching and learning, respond? Would we see teachers learning to do different things? Would programs have success in helping teachers think differently? In short, what could we learn about the role of teacher education in changing school mathematics?

Studying Learning to Teach Mathematics: Methodological Notes

A significant part of the NCRTE's contribution to the field centers on our methodological and conceptual work. Studying teacher learning entailed figuring out what to examine and developing credible means to examine those things. Several articles and technical reports deal extensively with our work in these areas (see, for example, Ball and McDiarmid, 1988, 1990; Kennedy, 1990; McDiarmid and Ball, 1988; NCRTE, 1988) and comprise a major contribution to teacher education research, policy, and practice. Below we summarize three outcomes of this work that relate specifically to studying learning to teach mathematics, one centered on conceptualizing subject matter knowledge in mathematics, another on fruitful tasks for eliciting and studying teachers' understandings of mathematics, and one on issues of context in interviewing teachers about mathematics.

1. How did the NCRTE conceptualize subject matter knowledge of mathematics?

With a few notable exceptions (e.g., Grossman and Richert, 1988; Shulman, 1986; Wilson and Wineburg, 1988), teachers' subject matter knowledge has been of little interest in discourse about teacher education. Distinctive in our work is that we not only paid attention to it as one main aspect of learning to teach, but that we conceived subject matter knowledge as more than facts and procedures that could be measured with a paper-pencil test.

First, we differentiated two main aspects of mathematics knowledge: one we called knowledge of mathematics, the other knowledge about mathematics. Knowledge of mathematics refers to knowledge of particular concepts and procedures and connections among them. Knowledge about mathematics refers to ideas about what it means to do and to know mathematics, what counts as legitimate mathematical thinking or activity, how answers may be verified or conjectures proved. It also includes ideas about the uses and origins of mathematics and about the relationships between school mathematics, everyday mathematics, and mathematics as it is practiced in the discipline.

Because our interest in subject matter centered on its role in teaching and learning to teach, our focus was on subject matter knowledge for teaching. From the start, we assumed that explicit knowledge of mathematics was necessary in order to help others learn; that is, although just "being able to do it" might be sufficient for some occupations, teachers need to explicate mathematical ideas, procedures, and relationships—whether to themselves or to students. Selecting examples, creating assignments, responding to students' questions—all of these common tasks of teaching draw on the teacher's own ideas about the mathematics entailed. We assumed that this was true regardless of a particular view of good mathematics teaching. Whether teachers do the explaining or whether they help their students construct their own understandings, they need to know that 1/2 is equivalent to 3/6, how to identify or produce other equivalent fractions, and what "equivalence" entails. Across the central tasks of teaching—such as selecting examples, making assignments, responding to students' questions—teachers' own understandings figure in significant ways.

We assume that, regardless of a particular view of good teaching, teachers need understandings of mathematics that fit with accepted knowledge in the field—that is, that their knowledge would need to be correct. Teachers, we assume, should know that rectangles are plane figures with four straight sides and four right angles and that the interior angles of a triangle add up to 180°. They should be able to correctly divide 4.05 by 0.5, know that division by zero is undefined, and be able to distinguish between a variable and an unknown. We argue that teachers' own understandings would shape the simplest of teaching tasks, such as correcting students' papers, responding to queries, using concrete materials, or illustrating a point in class.

Many would claim that teachers need understandings of mathematics that are more than just correct, that they need to understand underlying meanings and connections. For example, with respect to division by zero, they should know what it means for it to be "undefined" and be able to connect this meaningfully to basic ideas about divisibility. In dividing 4.05 by 0.5, they should be able to model this example and be able to explain what the answer—8.1—means. They should be able to explain and illustrate what 0.5 and .05 signify and how these representations relate to place value numeration and to fractions. Others argue that neither teachers nor students need to understand the whys in mathematics—that proficiency and skill are most crucial. But the press for "understanding" is prominent in current discourse about mathematics teaching and learning and we did include this aspect in our approach to exploring teachers' mathematical knowledge.

With respect to knowledge about mathematics, we focused on what teachers thought about the nature of mathematics and on their ideas about justification—explaining, verifying, or proving mathematical propositions. We chose these two for their centrality to teaching.

Teachers' own ideas about what mathematics is—where it comes from, what it is for, how certain or changeable it is—all seemed to us to bear on the subtle and not-so-subtle ways in which they represent mathematics for students. Ideas about justification are central because of the teacher's own role in legitimating particular answers or conjectures in the classroom. Teachers also sanction, encourage, and often even require particular approaches to establishing the truth of an idea or an answer.

2. What did the NCRTE find about fruitful approaches to studying teachers' mathematical knowledge? A basic premise of our work was that, in teaching, teachers' understandings of and ideas about mathematics interact with their ideas about teaching and learning, the teacher's role, learners, context, and even the purposes of schooling; that is, what a teacher does in planning for class, responding to a student, giving a test, or giving an explanation, is shaped by multiple factors in the situation. Mathematics knowledge is but one of those factors and the relative influences of these factors is an empirical and idiosyncratic matter. This conception of knowledge use in teaching led us to focus the bulk of our exploration of subject matter knowledge situated in the context of pedagogy. We created interview tasks and questionnaire items framed in common tasks of teaching: assessing student learning and responding to students, deciding what to teach, evaluating textbooks, and choosing instructional representations. And we also observed teachers actually teaching, although this source of data was central only in our studies of practicing teachers (in the induction, alternate route, and inservice programs). The interviews and questionnaires were central for preservice teachers.

The following example illustrates the strategy employed in our interview design. One interview scenario describes a student who comes to class and, with great excitement, announces that she has discovered "something new" and that she has an example to "prove it." The idea she shows the teacher deals with a generalization about the relationship between the area and perimeter of a figure. Although the student is very excited and proud, the idea she claims is actually false. Furthermore, the notion that her example constitutes proof of her discovery is problematic: In mathematics, one example can do no more than illustrate—not prove—a conjecture. This realistic situation presented teachers whom we interviewed with a classic teaching dilemma, in which their mathematics knowledge must be combined with other ideas and commitments—such as how to encourage girls' confidence and success, what to do when a student brings in an idea that is not part of the plan, what the teacher's role should be in verifying students' ideas, how to weigh the needs of the individual with the needs of the entire class, and so on. Teachers' reactions to this scenario gave us insight into many aspects of their teaching knowledge and beliefs, as well as specifically their understandings of the mathematics embedded in the situation.

Some scenarios we constructed were simpler than others. In some we related a student's query or claim and asked teachers how they would respond as well as what they would take into account in deciding how to respond. In one, we presented teachers with two contrasting textbook lessons on the same topic and asked them to compare the two, appraising their relative strengths and weaknesses, and considering whether and how they would use either set of materials. Still others were built on students' written work and consisted of asking teachers to talk about their interpretations of that work and what they might do if they were the teacher.

We found this situated approach to exploring teachers' subject matter knowledge in mathematics to be successful. Many of our items worked well as vehicles to learn about teachers' understandings of and ideas about mathematics and also helped us to understand how their mathematics knowledge interacted with other ideas and beliefs. Crucial to the effectiveness of this strategy, we think, was the construction of credible scenarios into which teachers could reasonably imagine themselves. These scenarios had to be sufficiently plausible that they could happen in a wide variety of contexts and to which there could be a range of possible interpretations and responses, not dependent on a singular view of good teaching. A teacher who conceives mathematics as skills and rules must be able to read herself into the question just as well as one whose emphasis is on problem solving and understanding.

Delving into participants' understandings of subject matter seems at time to border on a "test." As described above, we chose to contextualize our questions as a way of managing this problem: For instance, instead of asking teachers directly how to punctuate a sentence or to organize an essay, we ask them to respond to a student who posits something (either right or wrong). Instead of asking them to explain what a particular division problem means, we ask them to come up with a story that fits with it. These pedagogic frames alleviate the "testing" factor in our instruments. We recognize, however, that this approach weakens our ability to make claims about teachers' knowledge in separate frames—mathematics, teaching, learning, learners, context.

3. What did the NCRTE learn about interviewing and observing teachers in mathematics? This question is important because mathematics is an area in which many people in our society do not feel comfortable—researchers and teachers alike, in this case. We found that researcher training was a crucial component of our strategy, and we spent considerable time piloting, discussing, and analyzing trial interviews. Researchers needed time to explore and talk about the questions and, in particular, to gain comfort with the various dimensions of the mathematics embedded in each question. Similarly, practice was needed in order to prepare for classroom observations. This practice was both field-based and from videotape, and we had group discussions of what was seen and what might be fruitful to inquire about in a postobservation interview.

As is evident from the discussion above, the design and use of skillful probes were crucial to the success of our overall approach to interview and observational data collection. These probes needed to help us gently investigate further statements made by the teacher that would obscure, for instance, how they themselves thought about the mathematics in the question or the classroom situation—that is, their own understanding of the subject matter. These probes needed to be well-designed and carefully used. We grew to appreciate the importance of tone of voice, pacing, and stance of the interviewer, and we spent considerable time rehearsing and preparing for the interviews. Researcher preparation to use such sensitive strategies was important both in order to help the researchers feel comfortable but also so that they could be most effective in setting teachers at ease and softening the context of the interview.

Many teachers and prospective teachers seemed anxious about being queried about mathematics, even in the context of their teaching. This was true of elementary as well as secondary teachers and is undoubtedly related to the aura that surrounds mathematics in

this society. For elementary teachers, it seemed that they may have been anxious because they did not consider mathematics a strong suit (in itself an important finding of our research—see below), while the secondary teachers may have been worried because, for them—as mathematics majors—it was supposed to be. We did find, however, that the researcher's sensitivity and skill in introducing, framing, and probing the interview questions had a dramatic impact on the comfort and effectiveness of the interview. Well beyond the actual words, the researcher's facial expression, stance, tone, pacing, and general "feel" played an important role in the shape and success of the interview conversations. Researcher training was, we think, an essential component of our strategy.

Although we chose to take the position that subject matter knowledge for teaching had to be explicit, a caveat on more general teaching knowledge is necessary. In using interviews as a major means for collecting data, we assumed that teachers could articulate what they know, that their knowledge and beliefs would be explicit and articulable. In fact, of course, this is variable. Teachers, like other experts, rely on much that is tacit and intuitive. To find out what people are thinking or why they do what they do, we must ask them to talk to us. Yet the answers we receive may or may not be reliable representations of what they think or assume. For example, what underlies a teacher's decision to respond to a pupil in a particular way may depend on tacit assumptions about her role or the purposes of learning mathematics as well as on what the teacher tells us about pupils or about the content itself.

Trends Across the Data on Learning to Teach Mathematics

In this section, we present seven selected findings from our analyses of programs and teachers. These findings are illustrative of what we have learned and contributed to the field. They represent the kinds of central questions and ongoing analyses that researchers at the NCRTL are continuing to pursue. They were selected also because, as a set, they raise some thorny issues for research, policy, and practice. Three of the findings center on teacher education programs; four focus on teachers' learning.

1. The courses and other mathematics-related teacher education sessions that we observed at both the preservice and inservice levels tended to emphasize teaching techniques and methods. Some focused on improving teachers' attitudes toward the subject. Only one preservice program made as its central agenda the mathematical understandings of its elementary candidates. No program made a deliberate attempt to link concerns for culturally-diverse students to issues of mathematics pedagogy.

In one analysis of mathematics methods courses in three preservice teacher education programs, researchers found that instructors were most intent on helping preservice teachers reduce their anxiety about mathematics and develop specific techniques and approaches for classroom teaching (see Floden, McDiarmid, and Wiemers, 1989). In order to help their students become more comfortable with mathematics, these instructors focused on making the ideas simple and fun and avoided making experiences intellectually challenging, which they thought would frustrate teacher candidates whose past experiences with mathematics

had typically been unsuccessful. Courses presented teacher candidates with strategies and gimmicks to engage elementary pupils and to make mathematics teaching more creative. This approach fit the expectations of teacher candidates, many of whom expressed the view that good mathematics teaching made learning fun for students.

One preservice program offered a four-term mathematics content and pedagogy sequence. This program, whose overall theme centered on teaching subject matter for understanding, emphasized helping preservice elementary teachers gain competence with mathematical ideas (see Even and Lappan, 1990; Schram, Wilcox, Lanier, and Lappan, 1988). It was the only program in which developing preservice teachers' meaningful knowledge was an explicit goal. Not surprisingly, it was also the only program in which elementary teacher candidates' understandings increased during teacher education.

No teacher education program made explicit links between issues of cultural diversity and mathematics pedagogy. Generally, issues of equity and cultural difference, when addressed were dealt with apart from concerns of specific subject matter.

2. Only two elementary teacher education programs (one preservice and one inservice) articulated a central focus on mathematics. Both of these were congruent with current reform trends that emphasize teaching for understanding.

Most of the programs we studied included some focus on mathematics teaching and learning—usually in the form of a mathematics methods course. Of the preservice elementary programs, all included one term of methods. All of the programs required one term of mathematics content for teachers. For all but one of the preservice programs, these two standard courses were not bound by any central thematic or philosophic orientation; that is, the courses were required, but their content was determined by whoever taught them. No particular programmatic theory drove these courses. In the remaining preservice program, learning to teach mathematics for understanding was emphasized. Teacher candidates participated in four terms of mathematics-related course work that interwove content, curriculum, and pedagogy. The theme of the teacher education program centered on teaching academic subjects for understanding, and so preservice elementary teachers' experiences with mathematics were linked to more general ideas about teaching and learning found throughout their professional course work.

We also studied an inservice program that focused on developing in teachers a constructivist view of mathematics learning and consequent implications for practice. In this program, experienced elementary teachers engaged in an intensive two-week summer institute and a year of in-classroom follow-up. This program was notable for its coherent focus on mathematics learning and on changes in the mathematics teacher's role. Although the two programs differed in many specific ways, both this inservice and the preservice program offered participating elementary teachers opportunities to rethink their ideas about traditional school mathematics and revise those ideas in the direction of current reform trends.

3. At the start of their programs, many preservice and experienced elementary teachers in our sample felt uncomfortable with mathematics and did not feel confident in their own ability to understand or use mathematics. Some reported not liking the subject and had avoided taking it in high school and college. Others were matter-of-fact about it, but none seemed passionately interested in mathematics.

We asked teachers directly how they felt about mathematics. Twenty-three percent reported disliking and feeling unsure about their competence with mathematics, and none reported being highly enthusiastic and fascinated with mathematics. When asked to identify and talk about someone they knew who was "good at math," only one person identified herself. Twelve percent reported feeling highly anxious about mathematics. We also made judgments about the teachers' feelings about mathematics based on the tone and nature of their comments throughout the mathematics portion of the interview. The results of these ratings were, for the most part, congruent with their self-reports.

4. Few preservice teachers—either elementary or secondary—increased or deepened their understandings of or ideas about mathematics during their undergraduate education. Still, our findings are not as dismal as they seem. While all but one of the preservice programs seemed to make little difference with most students, some trends indicate that teacher education can make a difference in preservice teachers' mathematical knowledge.

Our baseline data showed that incoming students in teacher education had weak understandings of mathematical procedures that they had, for the most part, learned to perform. They tended to see mathematics as a series of rules and procedures, much of which was arbitrary and had to be memorized. For example, at the baseline, only 20 percent of the preservice elementary and 38 percent of the preservice secondary (who were majoring in mathematics) were able to select the correct meaning of $1\ 3/4 \div 1/2$ from among a set of alternatives on a questionnaire item. And still smaller proportions were able to generate an appropriate representation correctly in an interview.

Programs seemed to differ in their impact on prospective teachers' understandings of mathematics. In general, many prospective teachers finished college still having difficulty with ideas such as place value, division of fractions, and proof and seeing mathematics as a body of rules. For example, our questionnaire data show that, of the elementary teacher candidates across our five sites who were unable to select an appropriate representation for a division expression when they entered the teacher education program, 69 percent finished up still unable to do so. In fact, two-thirds of those who selected a correct representation at the baseline selected an incorrect model at the end. The results with the secondary majors were a little better. Of those who did not select an appropriate representation at first, 46 percent were able to do so when they graduated. These results are, nonetheless, discouraging in some ways. Altogether, only 55 percent of the secondary majors selected an appropriate representation at the end of their program. Many who make assumptions about what is learned from majoring in mathematics would have taken for granted that these students would have found this task trivial and obvious.

On the interview, we asked participants to generate a model for a division of fractions item. This is clearly a more difficult task than it is to select an appropriate representation from among a set of choices on a questionnaire. Forty percent of the secondary and only 17 percent of the elementary majors were able to explain and unpack the meaning of division fractions in the interview. One of the secondary students commented that "I can't think of anything in the real world where you can divide by a fraction." Their stumblings were painful at times as they struggled to make sense using a mathematical background that had been "directed," as one student said, at getting the right answer, not at understanding why. Here are a couple of examples (for 2¼ ÷ ½):

> *Prospective secondary teacher*: "If a kid has two apples and he bites one fourth of one apple and he bites half of another apple, how much apple does he have leftover?"
>
> *Prospective elementary teacher*: "You can do a sports model. If it's a field, we could have a miniature baseball or football or soccer field and have the measurement of this 2¼ and ½ and say, 'This team came to this side' or moved this far.'"

These responses illustrate a tendency for teacher education students, upon graduation, to value manipulatives and pictures and diagrams. Often they spoke of the need to use such models, but were unable to make pedagogical use of these materials because of the thinness of their own mathematical knowledge.

However, we also discovered program differences, suggesting that teacher education can make a difference in prospective teachers' mathematical understandings. The interview data reveal some of these patterns. For example, at some sites, the prospective teachers tended to focus on the content, analyzing it online during the interview, even as they tried to form a representation for the statement. For example, one elementary major explained, "I guess maybe it would work if you said, 'Okay. It's going to be this specific size portion and you have 2¼, then if you made the portions half as big, you can get twice as many out of it. Which 4½ would be twice as many as 2¼.'" These students, unable to do this kind of thinking at the beginning of their program, were able to do so at the end. Other students, from other programs, emphasized pedagogical methods and materials, but were unable to mesh these with the specific content because they did not understand it themselves.

Table 1 is based on analyses for the division of fractions item, based on the Wave 1 and Wave 2 questionnaire responses of 83 elementary and 22 secondary teacher candidates across all five preservice sites. The table below (Table 2) shows the related Wave 2 interview responses of 30 elementary and 10 secondary preservice teachers.

Similar results were obtained with other questions. For example, we asked teachers how they would respond to a student's claim that as the perimeter of a figure increases, its area also increases:

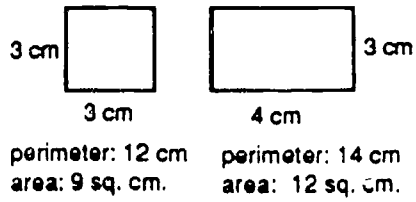
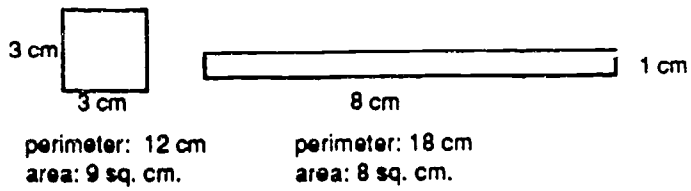


Figure 1. Student's "proof" that the area of a figure increases as the perimeter increases.

In addition to the mathematics of perimeter and area, this question embeds ideas about what counts as a "proof" in mathematics. The student claims that this single example proves the claim, yet, in mathematics, examples do not "prove." Only 16 percent of the preservice teachers knew that perimeter and area are not directly related—that is, that the perimeter of a figure can increase and the area decrease:



And only about 5 percent attended explicitly to the insufficiency of a single example to prove an assertion. Knowing what it might mean to "know" something in mathematics did not seem to be a central concern. Instead, they focused on whether or not the student was right and they saw themselves as teachers responsible to determine that and to respond on the basis of that determination.

5. The two teacher education programs that focused on mathematics teaching made a significant difference in teachers' beliefs about mathematics teaching and learning, as well as on their knowledge of mathematics.

Many of the preservice and inservice elementary teachers in our sample are either unaware of, or do not understand much about, mathematical reasoning. Fewer than 5 percent conceive of mathematics as a domain of human inquiry like biology or sociology. They see little connection between mathematics and other subjects, and computation dominates their sense of how mathematics connects to everyday life. Often uneasy about

Table 1

Changes in Preservice Teachers' Ability to Select an Appropriate Representation for a Division of Fractions Expression on the Questionnaire

	Elementary n = 83	Secondary n = 22
Incorrect both times	45 (54%)	8 (36%)
Incorrect at Wave 1 and correct at Wave 2	20 (24%)	7 (32%)
Correct at Wave 1 and incorrect at Wave 2	12 (15%)	2 (9%)
Correct both times	6 (7%)	5 (23%)

Table 2

Preservice Teachers' Ability to Generate an Appropriate Representation for a Division of Fractions Expression in an Interview at the End of Their Teacher Education Program

	Able to generate appropriate representation	Unable to generate an appropriate representation
Elementary (n=30)	5	25
Secondary (n=10)	4	6

their own mathematics, many preservice teachers—both elementary and secondary—lack meaningful understandings of content they have "learned."

Much of our data shows little change in these aspects of teacher knowledge and belief over the course of preservice teacher education. Preservice teachers finished their programs still holding undeveloped understandings of mathematics. Teacher candidates in the preservice program that focused on mathematics teaching, learning, and content, did make some substantial shifts. The researchers involved in studying that program claim that the course sequence promoted conceptual change in teacher candidates' beliefs about themselves as learners of mathematics, what it means to know mathematics, and how mathematics is learned (Wilcox, Schram, Lappan, and Lanier, 1991). The inservice program also achieved substantial shifts in experienced teachers' notions about mathematics teaching and learning, as well as in many participants' practice in their classrooms. These findings from the two programs with an explicit and sustained emphasis on mathematics and mathematics pedagogy suggest that teacher education can be a significant intervention in preservice and inservice elementary teachers' ideas and knowledge about mathematics teaching, provided that programs make a concrete and sustained effort to provide teachers with opportunities to learn about mathematics, mathematics pedagogy, and themselves.

6. Although some preservice teachers in our sample significantly changed their beliefs about mathematics or mathematics teaching, some nevertheless taught mathematics in traditional ways in schools.

Only one of the preservice teacher education programs placed considerable emphasis on helping prospective teachers change and develop their ideas about mathematics and the teaching of mathematics. Teacher candidates in this program displayed dramatic changes in their conceptions of mathematics, of themselves, and of mathematics pedagogy. Still, intensive longitudinal case studies of students in this program revealed that they were nevertheless inclined to teach in more traditional ways in the classroom (see Wilcox, Schram, Lappan, and Lanier, 1991). Various explanations are offered for this outcome. One is that contextual constraints interfered with these beginning teachers' efforts to teach differently, that what was encouraged and supported in the schools was discrepant with what they had learned in their program. Another explanation is that, although teacher candidates' experiences in their program led them to revise their own attitudes toward mathematics and gave them images of alternative pedagogy, these experiences were not sufficient to convince them that these approaches were feasible with elementary students or in public school classrooms. Yet another is that, although they held better ideas about mathematics and teaching mathematics, they still needed help translating these ideas into actual classroom practices. Whatever the explanation, these findings highlight the importance of contextual support and guidance for beginning teachers if they are to be successful in trying to teach in nonconventional ways.

7. Our data did not reveal big differences between beginning and experienced elementary teachers in terms of their views of mathematics, understandings of mathematics, or conceptions of mathematics teaching and learning. Both groups tended to emphasize making mathematics "fun" for pupils, by using concrete materials and other gimmicks to help pupils learn, and both groups varied in their own understandings of the content.

In an analysis of beginning and experienced elementary teachers' ideas about teaching subtraction computation with regrouping, more variance was found within than between the two groups (see Schram, Feiman-Nemser, and Ball, 1990). This result is striking, given that the experienced teachers had taught for an average of 10 years and had dealt with this topic in their teaching. Some conceived subtraction with regrouping as mostly a matter of teaching pupils to "line up the numbers" correctly and using some kind of gimmick that could help students remember not to "subtract up" when the number on the top is less than the number on the bottom, for example,

$$\begin{array}{r} 53 \\ -27 \\ \hline \end{array}$$

Others spoke more about the place value concepts entailed. The most developed explanation of subtraction with regrouping and what is entailed in "borrowing" was produced by a first-year teacher.

In another analysis, comparing beginning and experienced teachers' understandings of the algorithm we use to multiply large numbers, for example,

$$\begin{array}{r} 345 \\ \times\ 476 \\ \hline \end{array}$$

showed that the two groups differed little in their ideas and their ways of expressing and explaining them (see Ball, in press). Both teachers and prospective teachers relied on using "placeholders"—either putting down zeroes or using x's to fill in the spaces. Very few in either group were able to explain <u>why</u> the numbers "move over" or what the number in the partial product on the second row <u>meant</u>. Similarly, both preservice or experienced teachers had difficulty making sense of a division of fractions item, frequently unable to generate an appropriate representation.

These findings raise questions about what is learned from experience. Much about teaching is, after all, learned in the doing: for example, how to monitor pupils' thinking, ways to engage students in reading, how to conduct a discussion. Because of this faith in the educative power of teaching experience, many teacher educators are undisturbed at the lacks exhibited by teacher education students when they graduate from their preservice programs. They assume that what they lack will be developed from experience. Our data show that preservice elementary teachers' understandings of mathematics, thin and problematic when they enter teacher education, are often still weak when they graduate as

well (see above). Some teacher educators would shrug, asserting that "you only figure something out when you try to teach it." Yet our data on the mathematical understandings of experienced elementary teachers reveal few differences: they, too, lack understandings of underlying meanings and seem to conceive of mathematics largely in terms of rules and procedures.

These data raise questions about the taken-for-granted faith in experience: What, after all, in the practice of teaching pupils to multiply large numbers, divide fractions, or subtract with "borrowing" would provoke a close examination of the content or effect conceptual change? If using "placeholders" or "invert and multiply" seems to work, why would teachers learn new understandings of the content from their teaching? Teachers can rely on the way they were taught and manage to be successful in those terms. Our data suggest that secondary mathematics teachers may be in a somewhat better position to learn math content from their teaching (McDiarmid & Wilson, 1991). Still, some topics or ideas may be easier to learn from practice than others. For example, teachers may become more able to construct meaningful representations of division by fractions but not develop—or try to develop—insight into why division by zero is undefined.

Conclusions

The findings of the Teacher Education and Learning to Teach Study underscore the formidable challenges that face teacher educators who work with mathematics teachers. One thing is clear: At the preservice level, teacher education must take mathematics and mathematics pedagogy as an explicit focus in order to make a difference to students. Only in programs which focused directly on mathematics did we see changes in prospective teachers' understandings of mathematics, their notions of mathematics pedagogy, or in their dispositions related to the teaching and learning of mathematics. Figuring out how to provide fruitful opportunities for learning that can help prospective and experienced teachers learn to teach mathematics is not easy. Our data show that simply requiring prospective teachers to major in mathematics at the university is unlikely to make a significant difference. Yet, the usual course for teachers or math methods course seems inadequate as an intervention. Looking more closely at the two programs in our study that achieved significant change in teachers' understandings and commitments may provide useful stimulus and images for others teacher educators who want to develop effective programs that can help prospective and experienced teachers learn to teach mathematics. Our own ongoing work focuses on alternative opportunities for teacher learning in mathematics and should contribute to questions about the nature of effective mathematics teacher education. In particular, questions must be pursued about mathematics education that can help prospective and experienced teachers learn to teach mathematics differently from the way in which they were taught, in ways that draw on current reform recommendations.

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Chapter 3

LEARNING TO TEACH WRITING

There are numerous reasons for caring about teaching writing. One is that writing is taught at virtually every grade level and in virtually every subject; that is, even teachers whose formal responsibilities are to teach history, science, or social studies may still find themselves teaching writing. Therefore, learning to teach writing is important for all teachers, not just for prospective English teachers.

Another reason for caring about learning to teach writing is that findings from the National Assessment of Educational Progress—NAEP—(Applebee, Langer, Mullis, and Jenkins, 1990) have indicated that students in U. S. schools are, in the main, unable to write passages that require more than simple reporting. This means that, for instance, when asked to write texts that require them to develop arguments, the texts they produce are rarely acceptable. There is, then, reason to believe that the quality of writing instruction in contemporary American schools is not as good as it should be.

Several hypotheses have been generated to account for these failures of American education. The most plausible one is that teachers are teaching students writing conventions, but are not teaching them how to use these conventions to generate demanding forms of text such as fiction or essays. The reason for this emphasis has deep roots.

Throughout most of history, writing has been construed as consisting of two incompatible sides. One side, the self-generating and inventive side, has never been understood. It was perceived by ancient Greeks as mysterious, deriving from mystical—even evil—powers (de Romilly, 1975). Ever since, writers have talked of waiting for the muse, as if they themselves had no control over their ideas. The other side, the communicative side, requires adherence to a set of shared language conventions. This bifurcated view of writing—as consisting separately of creating new text and conforming to established rules—persists even today and has been reified so much that these two sides of writing are often viewed not only as separate, but even as antagonistic toward one another. Thus it is possible to find writers spurning conventions as if they hindered the creative side of writing, and to see creativity spurned as if it might lead to a Tower of Babel.

In the 19th century, John Genung argued that the creative, mysterious aspect of writing could not be taught, and that, therefore, writing instruction should concentrate exclusively on the aspect of writing that could be taught: conventions of punctuation, grammar, and language usage (Young, 1982). His ideas have dominated writing instruction ever since.

In the past two decades, as cognitive researchers have begun to seriously study writers and writing, we have come to better understand the nature of writing, not as one or the other of these two sides, nor as a staged process which starts with creativity and ends with conformity, but instead as an ongoing dance between the two. Writers do, of course, generate their own text. But texts rarely spring forth full grown. Instead, the writer negotiates between the content, the imagined audience, the genres and conventions he needs to work within, and the impact he wants to have. Writing, then, is an iterative problem-solving process that requires constant adjustment of each aspect of writing to the constraints imposed by other aspects of the task.

Both theory and empirical evidence regarding methods for teaching writing have led us to new, and remarkably different, ideas about the teaching and learning of writing. The essence of this new research is that direct instruction in grammar and language usage not only fails to help students learn to write, but even hinders their ability. Students who receive a great deal of direct instruction in these areas actually decline in their ability to generate persuasive and coherent texts (Hillocks, 1987). Findings from the NAEP assessments of writing suggest that the traditional skills-oriented approach to teaching writing has been successful in enabling students to form complete and correct sentences and paragraphs. However, if students are to learn to develop arguments, and to use writing to further their own communication purposes, they must also learn to think about their writing—how to cast their ideas for particular audiences and how to improve the ideas themselves. An alternative approach to writing instruction, often called the process approach, appears to be more effective in promoting advanced writing ability in students. The process approach, as its name implies, helps students learn the processes of writing—drafting and revising and seeking advice from others, for instance. The idea is that students will find ways to improve their writing if encouraged to engage in revision, if they are writing a piece that is meaningful to them (rather than one that was assigned by the teacher) and if there is a real purpose for the piece other than demonstrating writing competence to the teacher. Students do still need help learning writing conventions, of course, but this assistance is most fruitfully given in the context of the students' own writing tasks, rather than being presented out of context, in an artificial school environment where writing has traditionally been done only to demonstrate one's skills for the teacher.

The Problem of Learning to Teach Writing

Virtually every prospective teacher who plans to teach writing has been taught writing through a different method than the method that teacher educators now advocate; that is, teachers learned the conventions of writing, but have not learned to use writing to formulate and develop their own ideas and to communicate them to particular audiences. Most would-be teachers of writing learned, as children, a limited version of writing, such that writing was portrayed as a set of discrete writing conventions that were unrelated to any particular writing purpose. Given their own education, they are likely to believe, as adults, that this list of conventions is the subject of writing. Moreover, they are likely to prefer this limited version writing to a more generative definition: If their own success as students contributed to their interest in teaching writing, and if that success rested on a particular conception of the nature of writing, teachers will want to continue defining writing in this limited way. It is not only the version of writing that they happen to know; it is also the version they are fond of and that led them to consider teaching as a career.

And they are likely to believe that the pedagogy they experienced as students was and is a productive pedagogy for teaching writing. For that is the pedagogy that gave them their knowledge of writing. Thus, reformers and teacher educators who want to alter teaching practices in schools face a population of teachers and teacher candidates who perceive writing differently, who perceive the teachers' role differently, and who perceive writing pedagogy differently than the reformers and teacher educators do. And these would-be

teachers have formed their beliefs over the course of some 13 to 15 years of schooling in which they have participated in a community that defined writing and the teaching of writing in these ways.

There is much for new teachers to learn, then, not only about the nature of writing as a process of generating useful texts, but about how students learn to generate their own texts and about how teachers can help them do this. And the role models teachers recall from their own elementary and secondary teaching will not help them much, for their own former teachers did not teach this aspect of writing. The task we face as researchers is one of ascertaining the nature of beliefs teachers hold when they enter teacher education and the extent to which these beliefs are altered as they participate in their programs.

The Problem of Assessing Knowledge about Teaching Writing

Several difficult conceptual issues needed to be dealt with before we could devise a method for tracking changes in teachers knowledge about teaching writing. We had to conceptualize not only the knowledge needed to teach writing but also the kind of changes in knowledge that we might observe. And we had to decide what kind or formats of data collection would be most likely to reveal these changes in knowledge and understandings.

Defining the knowledge needed to teach writing required us to delineate several pieces of teacher knowledge: knowledge about writing, knowledge about learning to write, and knowledge about the teachers' role in facilitating learning.

Knowledge About the Nature of Writing

If teachers are to help students learn to write more complex arguments, and to use writing to formulate their own ideas, they need to understand how the process of writing can enable such outcomes; that is, in addition to the traditionally recognized rules of grammar and other writing conventions that guide the construction of finished texts, teachers need to know how writers write, about the ambiguities inherent in writing, and about the struggles that must be made to form ideas and to convert those ideas into words. Teachers need to expand their conception of writing, moving from the view that writing is finished once a product conforms to writing conventions to a view that writing is never really finished, that texts evolve gradually to further the substantive and communicative intent of the author.

Knowledge About Learning to Write

If writing is a generative process, then learning to write necessarily entails experiences generating text. Whereas traditional instruction presented students with the specific rules of form that guide the construction of final products, the process approach to writing requires students not only to learn these conventions but also to learn to draft and revise, for instance, to clarify their ideas and to test those ideas on various audiences. Research on learning to write has suggested several important principles about the processes of learning to write. One is that students learn more when they have numerous opportunities

to generate texts and to revise these texts. Another is that they learn more when the texts on which they work serve their own purposes rather than those of the teacher; that is, students learn more about writing when they select their own writing tasks and write for real audiences. And yet another is that they learn the conventions of writing better when these are taught in the context of their own writing purposes rather than being taught in the abstract, separate from any particular purpose.

Knowledge of the Teacher's Role in Facilitating Writing

Historically, teaching in all subjects consisted largely of conveying to students, usually didactically, a body of factual knowledge. To teach writing in this way required that a body of knowledge about writing be formulated. But writing is a verb, not a noun. Giving students propositional knowledge about writing cannot assure that they will learn to write. If students learn more about writing when they try to achieve their own writing purposes, rather than demonstrating a list of specific skills for the teacher, then the teacher's role is necessarily a delicate one. Teachers much find ways of guiding and facilitating students, yet be careful not to appropriate the students' writing and make it their own.

The Center's Strategy for Tapping Teacher Knowledge

Traditional methods of measuring knowledge rely heavily on paper-and-pencil tests. However, such assessment formats often assume that knowledge consists largely of facts that can be recalled during the assessment situation. If we accept the traditional view that knowledge of writing consists mainly of writing conventions, we could generate a test of teachers' or prospective teachers' knowledge of these areas. And although we cared about teachers' knowledge of writing conventions, we also cared about their understanding of the nature of writing and we cared about their perceptions of their own role as teachers in helping students learn this. Moreover, we wanted to see whether and how their understanding was translated into teaching decisions, not simply whether they could recite these ideas on a test.

Three conceptual decisions were particularly important to our work. First, we had to decide the form in which teachers' knowledge about writing would best be expressed. Some researchers argued that we needed to assess teachers' knowledge of writing through samples of their writing. We rejected this idea in part because it would not have been feasible within our resource and time limitations, but more importantly, we were interested in the knowledge of writing that was most pertinent to teaching writing, not to writing per se. It is not clear that the ability to produce a good written product is relevant to the ability to teach someone else to do so.

A second important conceptual decision we made was in recognizing that the knowledge needed for teaching differed from knowledge of writing needed by others in that teachers' knowledge must be explicit. That is, the teachers' task is to assure that students learn particular things about writing, and they are more likely to be able to do that if they know what those particular things are. This aspect of knowledge is unique to teachers and distinguishes them from others who "know" about writing. Writers who know the processes

and conventions of writing need not be able to articulate this knowledge for others, but teachers do need to hold their knowledge of writing explicitly. This argument obtains not only for those situations when teachers are didactically teaching particular writing conventions, but also for those situations when teachers must decide what should happen in class, how to respond to student questions, or what goals to set for the school year.

The third important conceptual decision we made had to do with how teachers' knowledge would best be expressed for our purposes. We argue that teacher knowledge consists of several recognizable components—attitudes and beliefs about the nature of writing, knowledge of specific writing conventions or of research on the teaching of writing, pedagogical skills, and ways of reasoning about classroom situations. From this, we recognize a need to gather some data on each of these aspects of teacher knowledge.

Our approach was to devise three distinct measuring devices, each designed to tap different aspects of teacher knowledge. The first device was a questionnaire. In the questionnaire, we provided teachers with numerous opportunities to express their attitudes toward writing, their knowledge about writing, and their beliefs about writing. Second, we developed an observation instrument that enabled us to see how our sample of teachers actually behaved in their own classrooms.

Third, we developed structured interview which provided teachers with an opportunity to demonstrate how their ideas about teaching and learning writing applied to specific teaching situations. The interview presented hypothetical teaching situations to our respondents and asked them to describe how they would handle them. These teaching situations represented a range of situations real teachers must be prepared to deal with, and all required teachers to make some decisions about the nature of the subject—that is, what was important for students to learn in this situation—as well as about what role they should play as teachers in helping their students learn. Two of these hypothetical situations, for instance, required teachers to read a student text and decide how to respond to the student. Another entailed developing a unit of instruction on organization in writing. And a third required the teacher to respond to a student who asked advice on a simple question of verb usage.

Findings

1. College juniors enter teacher education believing they should emphasize the formal conventions of writing more than the purposes of writing.

To gauge teachers' and teacher candidates' perceptions of the importance of writing conventions, we included in our questionnaire several statements to which they could agree or disagree. These statements, shown in Table 1, indicate a set of beliefs that emphasize teaching only one side of writing—the side having to do with writing conventions. As Table 1 shows, college sophomores tended to emphasize this side of writing more than either beginning or experienced teachers did.

With respect to their views about what is important in writing, these students agreed with two seemingly incompatible statements: that writing should be judged for its technical correctness and that it should be judged for how well it conveys the author's message. Such

Table 1

Degree of Agreement* With Propositions About Learning to Write

Propositions	College Sophomores (N= 97-101)	First-year teachers (N= 39)	Experienced Teachers (N= 49)
A. Views about writing			
In evaluating students' reports or papers, it is important to assign considerable weight to technical correctness (Q. A68)	3.58	4.46	4.57
A piece of writing should be judged more for how well it conveys the writer's message than for how technically correctly it is written. (Q. A66)	2.74	1.84	2.04
B. Views about learning to write			
There is a logical progression to be followed in teaching particular punctuation skills to students. (Q. A75)	2.24	3.38	3.83
Students shouldn't be asked to write long reports or stories until they know the fundamentals of grammar, punctuation, and structure. (Q A69)	3.59	5.10	4.85
To be good at writing, you need to know the parts of speech and the terms people use to describe writing conventions. (Q A37)	2.77	3.46	3.46
C. Views about the teacher's role			
If students are to improve their writing, it is important for teachers to grade most student papers. (Q A70)	2.84	4.91	5.16

* 1 = Strongly Agree
4 = Neutral
7 = Strongly Disagree

a pattern could be interpreted as indicating confusion, or it could be interpreted as indicating the genuine dilemma of teachers of writing.

More important for our purposes, however, are their views about how students learn to write. The data suggest that these teacher candidates tend to believe that students needed to learn writing conventions before they can generate texts of their own, and that it is important for students to learn such things as the parts of speech and the terms people use to describe writing conventions. These findings suggest that these teacher candidates would be unlikely to give students opportunities to learn writing conventions in the context of their own writing purposes, but instead would be inclined to teach them writing conventions as if such conventions constituted all of writing.

Finally, they agreed that the teacher's role in teaching writing was to evaluate the texts that students produced, thus suggesting that students in their classes would probably be generating texts mainly for purposes of demonstrating their mastery of writing conventions for the teacher, rather than generating texts in order to develop their own ideas and communicate them to their own audiences.

To see how these attitudes would influence their teaching practices, we included in our interview a sample of student writing and asked respondents to react to it. The writing sample looked like this:

> Dophins are really not fish. Other fish have gill to breath in air and blow out again. Dophins have something that is called a blowhole.Dophins can only stay under water for apramitly six or senven minutes.
>
> Dophins are like other big, big water animals they eat other small water animal.
>
> The ocen is the only place that Dophins can live.
>
> The reason that the Dophins can only live in the ocen is because the Dophins have to live in salt water. Dophins are somewhat reladed to sharks and whales. There are only one kind of Dophins. There are very few places that have Dophins.
>
> Matter of fact there are only two places that have Dophins.
>
> The two places that have Dophins are the coast of Maine and Alaska are the only two places that have Dophins, The Dophins can weigh up to three tuns. In 1963 a man was killed by a Dophin.
>
> The Dophins name was Julie. The way they can tell is the markins on the Dophins tale.

When presenting this writing sample to our interviewees, we ask simply, "How would you respond to this piece of writing?" thus casting a broad net in our request for responses.

Our sample of interviewees included 35 prospective elementary teachers attending five different colleges; 16 prospective secondary English teachers attending three colleges; and 5 students from one university who did not plan to teach. Among the elementary candidates. only one planned to major in English, and four others planned a general humanities major. Among those planning to teach secondary English, all 16 were planning to major in English. The 5 juniors who did not plan to teach were all majoring in psychology. To the extent that their colleges or universities required writing courses for their freshmen or sophomores, these 56 college students would probably have been exposed to some ideas about writing and learning to write. Those majoring in English may have taken lower-division courses, but probably no upper-division courses yet. Most of those planning to teach had not yet taken any teaching courses.

Of particular importance in this teaching situation is the extent to which the teacher can help the student revise the paper in a way that suits the student's communication goals without converting the students' goal from one of developing his own idea to one of satisfying the teacher. Candidates' responses to the essay on dolphins were consistent with their beliefs about the importance of writing conventions. In Table 2, we group their responses according to the extent to which the teachers appropriate the text and make it their own versus helping the student improve the draft while still retaining ownership of it.

In the first group of responses, the teachers have appropriated the text from the student, giving the student explicit guidance on what needs to be changed in order to make the text acceptable. The largest fraction of responses were of this type. In the next group of responses, the teacher has requested revision, but has been not been very clear about what the nature of the revisions should be. Finally, in the last group, these college students have tried to raise questions or offer suggestions that will stimulate the student to improve the draft while still retaining ownership of it. This type of response is the most infrequent type we encountered among the college students participating in this study.

These teacher candidates presumably acquired their views about writing and about teaching writing through their own experiences as students of writing in elementary and secondary schools. The data suggest that, to the extent that preservice teacher education programs wish to promote an expanded view of learning to write, their task is not only to teach a new pedagogical technique but, in addition, to get these candidates to abandon ideas they already have about what is important in teaching writing.

2. The programs we studied differed substantially in their orientation toward writing and toward the teaching and learning of writing.

Even though research has made great strides in defining better ways to teach writing, very little is still known about how to teach the teaching of writing. The teacher education programs we observed went about their task in widely differing ways, and these differences are, therefore, of interest to us. Perhaps because the field of writing instruction is in flux, we found substantial differences in the programs we studied in terms of how they went

Table 2

Nunber of College Juniors' Proposing Each Response to a Student-Author

	Elementary (n=35)	Secondary (n=16)	Other A&S[a] (n=5)	Total (n=56)
Appropriation Responses				
Give lesson on conventions	17	2	2	21
Enumerate errors	6	4	0	10
Give outline to the student	0	3	1	4
Ask student to revise with ideas grouped	3	2	0	5
Tell student to use note cards or outline	2	1	1	5
Give student better references	2	1	0	3
Ambiguous Responses				
Request revision, no details re how	5	1	1	7
Ask student to revise with dictionary	5	2	0	7
Facilitative Responses				
Work with student on grouping ideas	3	1	0	4
Pose questions re details, purpose	0	3	0	3
Describe own confusion as audience	2	0	0	2

[a]Other arts and sciences students.

about preparing teacher candidates to teach writing. Preservice programs, inservice programs, and programs designed to help beginning teachers had different goals and strategies in part because they served teachers at differing stages of their development. Yet even within a particular category, such as preservice teacher education, we found that programs still differed substantially from one another. Those differences that we suspect are most relevant to teacher learning include (a) the degree of attention to the specific subject of writing and to the kind of pedagogy that is needed to teach writing; (b) the extent to which there was a coherent, program-wide orientation toward writing; and (c) the extent to which state, district, and school policies were consistent with and supported program efforts.

Attention to writing and writing pedagogy. Programs differed by the amount and intensity of attention they paid both to writing as a subject and to pedagogical issues that were specific to teaching writing. At one extreme was an inservice program in which teachers were involved in several all-day workshops devoted to writing and had access to trainers throughout the school year to help them learn both about writing as a subject and about appropriate pedagogy teaching writing (Ball and Mosenthal, 1990).

At the other extreme were programs that provided little or no assistance either in learning about writing or in learning how to teach writing. Neither of the alternative route programs in our sample, for instance, attended to subject-specific pedagogy in any subject area, but instead provided their candidates with a set of generic pedagogical principles that were intended to apply equally to all school subjects. However, in one case, secondary English teachers did participate in local workshops about writing and they received their generic pedagogical advice from other English teachers so that it was at least embedded in the context of the subject they would be teaching.

Most preservice programs provided candidates with one or two courses whose titles related to writing in particular or to, more broadly, language arts. Most of these courses introduced teachers to the pedagogy needed to teach generative writing, but did not teach about writing per se.

Coherent orientation towards writing. Since views about the nature of writing and about how writing should be taught have changed rapidly in the last two decades, the particular people within individual programs may differ considerably in their knowledge and understanding of these changes in the field. We found that programs differed in the degree to which their faculty espoused these new ideas about writing, and in the degree to which faculty agreed in their views about writing.

We use the term program coherence to refer to an integrated set of well-articulated goals that are shared among instructors, that are expressed through their courses, and that are extended from theory to practice. The most coherent program we observed was the inservice program, where faculty agreed with one another and espoused a coherent, interrelated set of ideas about writing and about teaching writing. This program view included the belief that writing should communicate to an audience for a particular purpose; that writing is a process of drafting, revision, editing and publishing; and that classrooms should be structured to facilitate writing for real purposes and audiences through the use of writing conferences with the teacher and with peers. The program directors and on-site

trainers believed in this set of practices themselves and demonstrated their use in workshops and on-site demonstrations.

No other program attained the degree of program coherence that this one did, though several others achieved their own particular forms of coherence. One, for instance, had a coherent program in the sense that the same instructor taught all of the methods course, thus providing students with a particular philosophy. Two others were largely sympathetic with this view but did not provide as forceful a presentation of these ideas as this inservice program did.

Two programs maintained a more traditional view of writing as a series of conventions to be learned by students. These programs, both preservice programs, had not explicated their view as clearly; that is, they had not explicitly embrace any particular view of writing, nor were their course offerings articulated with practice in the same way as those programs described above. Though faculty views were not necessarily coherent throughout the programs, these programs did tend to emphasize particular writing skills or handwriting techniques.

Still other programs espoused a generic view of teaching in which writing was not distinct from rest of the curriculum. These programs provided teachers with general teaching strategies that were intended for use in all subject matters and gave virtually no attention to the teachers' understanding of the subject matter per se. Both of the alternative route programs in our sample espoused this generic view of pedagogy. District or state curricular guidelines in the language arts were used as the content of teaching writing.

Supportive state and local policies. Another important dimension on which our programs differed was the nature of state and local policies surrounding the program. Despite the orientation of the programs, their teachers would be teaching in schools that were governed sometimes under quite different orientations than those of the programs. Among the programs we studied, we found wide variation in the degree of consistency between state and local policies, on one side, and the program's practices, on the other. At one extreme was the context in which the inservice program functioned. The program itself took place within operating schools, and teachers in these schools enjoyed both school building support from their colleagues and principal and school district financial support for the program and for the teachers' time while they participated in workshops. Another program with similar local support was an induction program offered jointly by a school district and a university. In this case, both the program faculty and local teachers shared an orientation toward a process approach to writing situated within the larger context of whole language. In addition, district guidelines supported the program, and state support groups existed for teachers.

3. Regardless of program orientation, teachers moved toward a process orientation toward writing; however, most changes in views were only marginal.

Although there were differences in the degree of change demonstrated across the programs we studied, teachers in all the programs moved toward a more expanded view of teaching and learning writing as they participated in these programs.

However, in many cases, these changes were only very slight. Figure 1 shows, for instance, changes in views about which aspects of writing are most important. It indicates that, regardless of the program's orientation, program participants tended to move from agreement toward neutrality regarding the importance of conveying the author's message and to move from neutrality toward disagreement regarding the importance of judging the technical correctness of a product. Their view about what is important in writing, then, did not alter substantially regardless of the program in which they participated.

4. Programs that combined a coherent orientation toward the writing process with intensive classroom assistance appeared to be more successful than any of the others.

Two programs in our sample combined a strong orientation toward a process approach to writing instruction with intensive classroom assistance in learning to implement this approach to writing instruction. One was an inservice program, the other an induction program. These programs were more able than any of the others to actually alter teachers beliefs about writing and their approaches to writing.

Both interview and observation data suggest that the inservice program had a high impact upon teaching practices. Participating teachers set up writing workshops with the structure of minilessons, conferences, and share sessions. Teachers seemed to embrace such ideas as writing for a purpose and writing within a social context (Mosenthal, 1989), and altered their views about the goals and purposes of writing (McCarthey, 1990). Some teachers' practices, such as using conferences with students, reflected incorporation of writing process principles (McCarthey, 1989).

Interview data suggest that the induction program also had some impact upon learners. The written literacy study group raised interns' awareness of the purposes and audience for classroom writing activities and the capabilities of elementary students to write. Interns also saw that pupils could write on a range of self-generated topics. A summer seminar gave interns experience with writer's workshop by enabling them to use this structure in writing their master's papers (Feiman-Nemser, Parker, and Camilleri, 1989).

5. There are numerous barriers to learning to teach the generative side of writing.

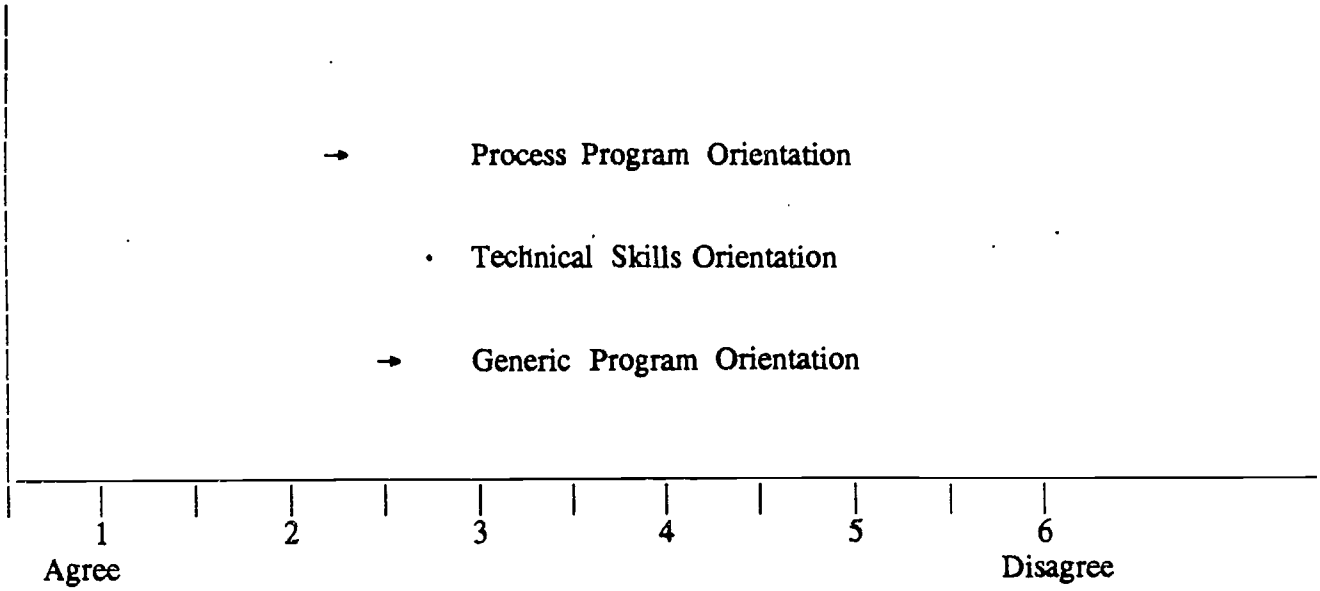
The dominant mode for teaching writing in American schools is to teach students a host of specific writing conventions and to give writing assignments largely so that students can demonstrate their mastery of these conventions. Helping teachers learn to teach the generative side of writing requires a substantially different approach to writing pedagogy, and even if teachers understand this approach and want to implement it, they may still face many difficulties. Three difficulties were especially apparent in our study: (a) the traditional school norms in which teachers worked, (b) the policy context in which they worked, and (c) the inherent difficulty of this approach to teaching writing.

Traditional school norms. Many teachers were confronted with traditional norms and ways of teaching writing either during their student teaching or when they began their full-time jobs in schools. These norms reflect not only a one-sided view of writing, emphasizing only writing conventions, but also the dominance of didactic approaches to teaching all

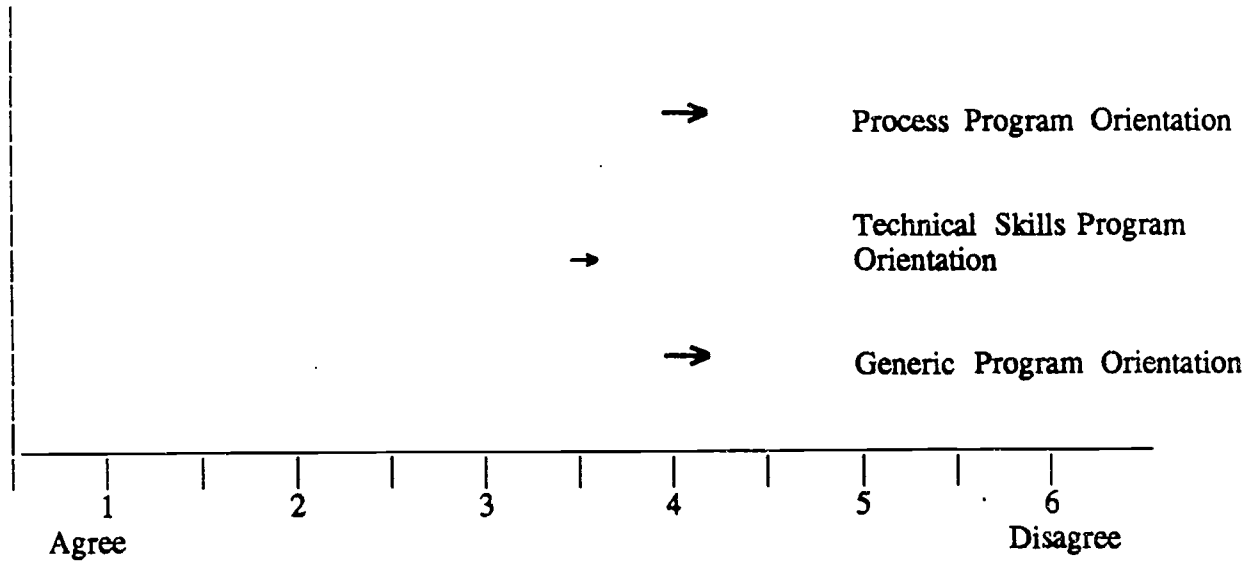
subjects. The influence of these norms was less noticeable when the teachers' teacher-education programs did not emphasize a process orientation, since their graduates were less inclined to try such an approach anyway. However, those teachers whose preservice programs most strongly emphasized the process approach to writing had difficulty implementing process approaches once they were in schools.

Policy contexts. Two states in which we studied teacher education programs had developed highly influential teacher assessment procedures that were incompatible with a process orientation toward writing. Both assessment systems were based on a set of generic principles of good teaching that apply largely to didactic instruction, and consequently created tensions for teachers who wanted to alter their approach to teaching writing. In one case, the state policy was consistent with the teacher education program's orientation toward teaching the technical skills of writing. In the other case, the state policy differed substantially from the teacher education program's orientation toward teaching writing. The conflict made it especially difficult for new teachers to practice the teaching strategies their program had emphasized.

Inherent difficulty of this approach to teaching writing. Even under the best of circumstances, when programs provided a strong and coherent orientation toward writing and the teaching of writing, teachers found it difficult to change their practices and to fit these new ideas about teaching writing into their traditional classroom structures. The only programs which yielded substantial changes in practice were those that included intensive, ongoing, in-school assistance.



Q. A66: A piece of writing should be judged more for how well it conveys the writer's message than for how technically correctly it is written.



Q. A68: In evaluating students' reports or papers, it is important to assign considerable weight to technical correctness.

Figure 1. Changes in view about what is important in writing.

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Chapter 4

LEARNING TO TEACH DIVERSE STUDENTS

A critical aspect of our research was our focus on learning to teach diverse learners. We wanted to learn more about what teachers know and learn about teaching learners who were racially, socially, and ethnically different from one another and from their teachers. We also want to find out more about the role that students' gender and their putative academic ability played in teachers' thinking about instruction. Specifically, we wanted to learn about which learner differences teachers believe to be salient to teaching and learning as well as how they think about accommodating differences in their classrooms. We also wanted to learn about the opportunities that teacher education programs offer for teachers to learn about teaching diverse learners.

Given the continuing failure of many schools to serve poor children and those of color, how teachers are prepared to work with such students is critical. What do they learn about the role of learners' home background in their school performance? What do they learn about their responsibilities for addressing differences in learners' knowledge and skills? To what degree do they believe such differences were amenable to instruction? What do they learn about ways to help learners catch up with their classmates? What do they learn about school practices—such as ability grouping and tracking—that many argue categorically deny students equitable access to critical knowledge?

Our strategies for gathering information on these questions were consistent with our overall strategy: Use multiple ways of tapping teachers' knowledge and beliefs and tap teachers' knowledge at different points in time in order to examine changes. Collecting valid data on these issues proved even more difficult than we had imagined at the outset, however, and part of the story we have to tell is of our various attempts to develop ways of finding out how teachers think about issues of learner diversity. We also collected information from program personnel on where and how issues of learner diversity are addressed in the teacher education programs we studied.

Some of the data we collected do, however, raise questions about what teacher educators are doing to help teachers deal with issues of learner diversity, particularly how to regard and treat generalizations about learners from specific racial and ethnic backgrounds and how to provide equitable access to equal knowledge. In addition, the data also raise questions about what teachers believe they are responsible for and capable of achieving with learners, particularly poor children and those of color.

Perhaps most significantly, our data also reveal a dilemma in preparing teachers for diverse classrooms. A participant in one of the programs we studied summarized this dilemma:

> It seems to be . . . the problem of "treat me differently because I'm different but don't treat me differently because I'm the same and I deserve the same treatment as everyone else." I'm constantly trying [to be sensitive to cultural differences] . . . but I like to look at my students as people and I try to treat them all equally. I can't expect to [learn these] . . . generalizations and hope not to be stereotyped in my treatment of them. (McDiarmid, 1990, p. 18).

Methodology

We developed three instruments to gather information on how teachers think and what teachers know about teaching subject matter to diverse learners. We attempted to include in all three instruments items that would tap teachers knowledge and beliefs about diverse learners in the context of teaching mathematics and writing. At the same time, on both the questionnaire and in the interview, we asked questions focused directly on what teachers think about the role of student differences—particularly gender, ethnic, and social differences—in teaching and learning.

Questionnaire

On the questionnaire, we included items in both the sections devoted to mathematics and writing and in the section made up of generic items. The usual problems inherent in using questionnaire data—for instance, not knowing how respondents interpret the question—were compounded by people's tendency to answer in ways they believe socially appropriate. While problematic in collecting data on a variety of topics, this tendency is particularly insidious when asking people about their views of and attitudes towards others who are socially, racially, and ethnically different from the respondent. The relatively high number of teachers who say they disagree with grouping and teaching practices, for instance, may reveal only that these teachers have figured out that this is the politically correct point of view.

As part of our attempt to understand which differences among children teachers believe are salient to teaching, we asked a series of questions about learners. Some of these focused on gender, some on social class, some on age, and some on ability. We were particularly interested in ability because differences among children attributed to ability are generally considered valid bases for making instructional decisions. Placing a child in a "slow" reading group because he is poor or black would be widely perceived as discriminatory. Placing a child in a "slow" reading group because he scored poorly on a standardized test is accepted practice.

Some teachers may regard ability as an acceptable criterion for grouping because they believe learners, in a sense, get the opportunities that they deserve. Some children, they may reason, may not be born with the natural ability they need to read, write, or compute well. Or some children may live in environments that do not foster their ability in these areas. How teachers define their responsibility given such beliefs is the critical issue. Some teachers may reason that ability is, to a large degree, a fixed quality: Either one is endowed by birth or circumstances to do math or to write well or one isn't. As a consequence, what teachers and schools can do to help children who lack ability is limited.

Other teachers, however, may define their responsibilities for children's development quite differently. Without denying that both genetics and environment may contribute to children's intellectual capacities, they may reason that all children are inherently capable of learning whatever is taught in school and the issue is one of creating opportunities for all to learn. We felt that finding out what teachers believed about ability and about their responsibilities for addressing such differences was a vital part of understanding their

disposition to help diverse learners learn subject matter. Consequently, we also included on the questionnaire several items about teachers' responsibilities for learning.

Interview

Our first attempts to get data on teachers' views of diverse learners produced results that fell well short of what we had hoped to get. We knew, at the outset, the problems with social response bias: Asking people directly about their views of others racially, ethnically, and socially different from themselves is likely to prompt them to respond in the way they believe they should respond. Prospective and practicing teachers know educated people are not supposed to judge others on the basis of their skin color, dialect, and so on.

Among our first efforts to tap teachers' beliefs about the role of students' ethnicity and race in teaching and learning was a question asking directly about what differences they thought mattered:

> One of the things we are interested in is knowing how teachers think about differences among students. When you think about the ways that your students are different from one another, what kinds of differences come to mind? Focus especially on those that you think are critical for teachers to consider.

This question, which we asked on the interviews that we did both at the beginning of their programs and a year after they had finished their program, included instructions for the interviewer to follow up the teacher's answer as follows:

> For each category not mentioned [e.g., gender, ethnicity, culture, language, handicaps, social class]: Some people mention _____ when they talk about differences that they think are important for teachers to consider. what is your view?

Because we used mathematics and writing as the context for learning about teacher knowledge, beliefs, and disposition, we also asked probes specifically about what kinds of differences among learners were relevant in teaching these two subject matters:

> Are there particular kinds of differences among students that are especially important to consider in teaching math/writing? Why?

As we discuss below, these questions yielded little about how teachers in the sample think about the role that categorical differences among learners play in teaching. Instead, teachers focused on individual differences (Paine, 1990).

With these results in mind, we next developed scenarios of the kind we had been using to tap teachers' knowledge and beliefs about teaching mathematics and writing. We focused each of these scenarios on a particular aspect of diversity: One focused on gender, another on ethnicity, and the third on social class and ethnicity.

In addition, as we were interested in how teachers think about issues of learner diversity in relation to the teaching of particular subject matters, we also added probes to some of the scenarios set in the context of teaching mathematics and writing. For instance, after asking teachers what they would do to help students learn how to indicate possession in their writing, we probed their thinking about the role of learners' background by asking whether or not they would do something different if most of their students were black.

While certainly problematic, the data that the diversity scenarios yield are both richer and, we suspect, more valid than data from the earlier direct question; that is, teachers reveal a great deal more about how they think about issues of diversity when they talk about a specific classroom situation than when asked generally about learners and differences among them. At the same time, however, we are unsure about the relationship between teachers' responses to the scenarios and what these teachers will actually do in classrooms replete with differences of race, class, gender, ethnicity, language, culture, and disability. Even when teachers seem to be uncritical of generalizations made about ethnic groups, we are not sure how this translates into classroom behavior.

The need for due caution in interpreting these data was underlined by the comments of a teacher educator during a presentation of the findings from a parallel study the Center conducted of a program designed to prepare student teachers for culturally diverse classroom in which the participants had been evaluated using the scenarios developed for the TELT study (see McDiarmid and Price, 1990). The faculty member rose to object that, contrary to the claims of the evaluation, he had seen certain changes among the student teachers he supervised who participated in the program. Specifically, he mentioned that student teachers who had participated in the program became more critical of the way that people of color were either excluded, underrepresented, or misrepresented in textbooks. His objection is a important cautionary tale: The means we devised to tap teachers' views of the role of learner diversity in teaching may be insensitive to other changes just as critical as are those we did tap.

Observations

In addition to the questionnaire and interview, we designed the observation protocol to collect information on how teachers deal with differences in teaching and learning. The principal problem with the observational data is that, given the design and the size of our sample of teachers, we could afford only one observation of most teachers in our sample after they completed their programs. Whether or not we saw activities and behaviors that would help us understand the teachers' disposition toward children who were socially, ethnically, or racially different from the teacher was chancy. The pre- and post-observation interviews did, for some teachers, generate rich data on teachers' views and beliefs. Because we asked questions about grouping practices and teacher decision making about individual students, we did risk provoking socially appropriate responses.

We believed from the outset of the TELT study that observations of teachers in classrooms would provide the most useful and valid data on teachers' views of teaching diverse learners. Such observations, however, are not without problems. For instance, the sample of activities that an observer sees may or may not be representative of what typically

occurs in a given classroom. And a number of indicators of teachers' views of diverse learners—such as the basis for instructional groups or decisions about activities and assignments—most often occur prior to actual classroom activities. Consequently, researchers remain dependent on teachers' retrospective self-reports of how and why they do what they do.

Summary

So, what have we learned about studying teachers' knowledge, beliefs, and dispositions in this area?

- Embedding issues of learner diversity in classroom scenarios that require teachers to respond to issues of learner diversity appears to elicit richer information on how teachers actually think about categorical differences and how these should or should not be factored into teaching.
- Although scenarios produce rich information on how teachers think about the role of categorical differences, exploring how teachers act on their understandings and beliefs would require frequent observations of teaching and opportunities to talk with teachers about their why they do what they do.
- Data elicited by questionnaire items on issues of learner diversity must be interpreted with particular caution. Not only are respondents likely to answer in socially appropriate ways but we do not know how respondents interpret the questions.
- Because of the role that individuals' past experience plays in their understanding of themselves and others, exploring their sense of themselves as learners may be critical to understandings their views of others as learners.

Trends in the Data

How Programs Treat Issues of Learner Diversity

In preservice programs, issues of learner diversity are largely segregated into social foundation or psychology courses. Two of the preservice programs required courses in the social foundations of teaching that focused specifically on racial, social, ethnic, and to some degree, gender differences. In the other three preservice programs, the issues of learner diversity were reportedly treated as part of the required educational psychology course. (The year after we collected our baseline program data, one of these three preservice sites instituted a new course on multiculturalism.)

Because we were interested in the relationship between learner diversity and other aspects of teaching, we examined mathematics methods courses in three of the preservice programs and secondary and elementary language arts methods courses in one of the preservice programs that is located in the state that has the second fastest growing minority student population in the country (Floden, McDiarmid, and Wiemers, 1990; McDiarmid, 1989). We found little evidence that instructors engaged preservice teachers in thinking about the instructional and learning implications of learner diversity for their subject matter.

In the case of the language arts courses, preservice secondary teachers who remain after graduation to teach in-state will work in schools for which the state department of education has recommended tracking in English courses. Although faculty in this program encouraged students to challenge the ways teachers have traditionally helped students learn to write, they appeared to ignore curricular and opportunities-to-learn issues implicit in state-recommended tracking.

The context of the programs we studied appeared to play a critical role in the formal attention program personnel pay to issues of diverse learners. For instance, the induction program—located in an urban district serving large Latino and Native American populations—encouraged teachers to think about the role that their learners' background played in their learning both to read and write. Intern seminars and clinical support appeared to be designed to foster such thinking. In part, this appeared to reflect the dominant view of language teaching and learning that permeated the undergraduate teacher education program from which the teachers had graduated, and that was reinforced by seminars and clinical support teachers. In addition, paying attention to the needs of diverse learners—particularly those whose language experience outside of school has been predominantly with a language other than standard English—was a value that program personnel stressed in both formal and informal learning opportunities.

Context also appeared to play a role in how issues of learner diversity was treated in the alternate route and inservice programs. One of the former, located in a large urban district that is among the most ethnically and linguistically diverse school districts in the country, included sessions on multicultural education in their initial three-week summer training. After their first year of teaching, teachers attended a week-long series of presentations on various topics related to multicultural education (McDiarmid, 1990). Program personnel designed this workshop, perhaps the most comprehensive of any program in the sample, to provide teachers with information on various ethnic groups; specific activities and ideas for including more information on ethnic groups in their curriculum, for encouraging cooperative learning among students, and for dealing with controversial topics; and injunctions to avoid certain attitudes and behaviors that might alienate children and parents of particular backgrounds.

Similarly, one of the inservice programs, located in another large multiethnic urban district, took as a given that teachers would be teaching in classrooms in which students would likely come from a variety of linguistic, ethnic, and social backgrounds. While not necessarily addressing issues of learner diversity separately, program personnel promoted a way of organizing instruction and a role in the learning process apparently intended to accommodate diverse learners.

Program personnel in charge of the other alternate route we examined featured issues of learner diversity less prominently in formal program components. Indeed, the program director, asked about the opportunities program participants had to learn about teaching diverse learners, reported that this was a program goal. The director went on, however, to describe only one "session" devoted to diversity and that was designed to introduce participants to Child Study Teams for special needs students. This may have been, in part, because the program was designed to prepare teachers for a variety of schools across the state, not only for schools in urban areas. Personnel in the other inservice program

similarly did not target teachers teaching in schools that served socially and ethnically diverse populations but rather tried to provide ways for rethinking what it means to know, teach, and learn mathematics. Program personnel appeared to believe that such rethinking of how mathematics is learned would serve teachers regardless of the students they taught.

In sum, we feel we learned a few things about how the programs we studied treat issues of learner diversity:

- The degree to which programs consider the issue of learner diversity a central theme in the program seems related to how they define their clientele and the contexts in which they teach.
- In preservice programs, issues of learner diversity are largely segregated in social foundation or psychology courses.
- Methods instructors, at least in those preservice programs we examined most closely, appear to pay scant or no attention to learner diversity and its role in teaching and learning and don't seem to include helping teachers think about this issue among their responsibilities.
- In programs that do address issues of learner diversity, faculty/personnel define preparing teachers to teach diverse learners as principally providing teachers information—about the history, culture, and preferred learning styles of various ethnic groups; the effects of institutional racism; and specific activities and techniques such as cooperative learning—and exhorting teachers to include in their own teaching more information about people historically excluded from the curriculum—women, people of color, and linguistic minorities, in particular.

What We Learned About Changes in Teachers' Knowledge, Beliefs, and Dispositions About Diverse Learners and the Role of Diversity in Teaching and Learning

As we pointed out above, although we collected information on teachers' views of diversity, we have reservations about the validity and reliability of these data. At the same time, some of our data suggest areas of teachers knowledge that we and others need to examine more closely in a variety of contexts. Below, rather than sort our data by source—that is, self-administered questionnaire or structured, scenario-based interview—we will bring to bear whatever data seem pertinent to the issue under discussion.

What Differences Among Learners Seem to Matter to Teachers in Making Decisions About Teaching and Learning?

A central issue is what differences among learners teachers think they should attend to in their classrooms and how they think these differences influence children's learning. In particular, we explored teachers' ideas about learners who are different from themselves—students who come from racial, ethnic, or cultural groups different from that of the teacher. Research on the effects of teachers' expectations on children's learning signals

the critical role that teachers' perceptions of learners plays in the classroom. A number of our items were designed to tap teachers' perceptions of different learners.

- In discussing diversity in the classroom, teachers tended to treat differences among diversity as a problem rather than a phenomenon, something teachers must overcome or solved rather than a feature of all classrooms.
- As we noted above, when asked straight out, preservice teachers in our sample claim that categorical differences—social class, race, gender—don't matter in teaching: All children are fundamentally the same.
- The only differences that teachers in the programs we studied seemed to believe matter are differences in personality—for example, that some children are shy.
- Teachers rarely mention that a student's group membership may actually influence the way he is treated by educators and, ultimately, how he comes to view school.
- Most teachers in the programs we studied believe that they can overcome student resistance to participating in class by reasoning with the students.

How Can Teachers Manage the Differences in Learning That They Find Among Their Students?

A dilemma in teaching is that learners come with a range of prior experiences with school and different subjects and a range of capacities. Consequently, in any classroom, differences exist among students in the sense that they make out of the ideas, materials, and other experiences they encounter and the understandings they develop of the subject. How should teachers deal with these differences? For many years, teachers have resolved this dilemma by individualizing instruction—allowing learners to progress through materials at their own rate. This resolution, however, appears to ignore the social as well as intellectual value of a group of people collaborating to solve problems or understand an idea or issue. Such collaboration is arguably more common in most jobs than is isolated, individual work.

What children have the opportunity to learn is another issue that individualizing instruction raises. When does tailoring instruction to individual needs become creating inequitable opportunities to learn critical knowledge? Teachers' capacity to address this question is as much a function of their understanding of what they teach—and what is most critical about the subjects they teach—as of their views of their learners.

- Many teachers in the programs we studied, especially preservice programs, approve uncritically of individualizing instruction as the primary way to address differences among students.
- Largely uncritical of individualizing instruction, most teachers do not mention the costs of individual instruction—such as the loss of opportunities to bring diverse points of view to bear on texts, questions, issues, or problems or to forge a community of learners in the classroom.
- Concomitantly, most teachers in the preservice programs we studied appeared to be indifferent to the academic content of the tasks elementary students of color are assigned. That teachers individualize to address individual differences seems to be,

in the eyes of many preservice teachers in our sample, more important that the content of the individualized task students are assigned.

How Much Responsibility Do Teachers Assume for Children's Success and Failure in School?

Given the relatively high rates of school failure of poor children and those of color, a critical issue is whether or not teachers believe they can make a difference with these children. Often, beginning teachers seem to think that some children are doomed to failure because of factors outside of the classroom—the children's home environment, for instance. Teachers' disposition to persist in working with such students may be related to the degree to which they believe they are capable of making a difference. In contrast, teachers might believe that, while students' home background and attitude are the major factors in their success and failure in school, the teachers' responsibility is to either capitalize upon or overcome these factors.

Beliefs about sources of school *success*

- Nearly half of the preservice teachers in our sample, both at the beginning and the end of their programs, believe that student enthusiasm is the primary factor in students' school success. Only 13 percent of these teachers at the beginning of their programs and only 17 percent at the end believe that teachers' methods are primarily responsible for students' school success.
- Forty percent of the teachers in the induction program believed, when they started their program, that students' enthusiasm is the main factor in their success. Almost 60 percent believed this at the end. Only 9 percent believed, at the beginning of the program, that teachers' methods are primarily responsible for students' success; the proportion believing this at the end of the program dropped to 5 percent.
- A significant number of participants in the alternate route do appear to change their beliefs in this area between the beginning and end of their programs. While only 15 percent believed, at the beginning of the program, that students' home background is the primary factor in their school success, 31 percent do so at the end. The proportion who believed students' enthusiasm is the primary factor does not seem to change from the beginning to the end of the program: 38 percent cited this factor on both occasions. Those citing teacher factors—that is, attention to student uniqueness, methods, or enthusiasm—diminished from 46 to 27 percent.
- Inservice teachers are distinguished from the other groups by their apparent belief in the primary role of the teacher in student success. Forty-five percent at the beginning and 56 percent at the end chose teacher factors—mainly, teaching methods—as the primary source of student success.

Beliefs about sources of school *failure*

- Just as they believe learners are primarily responsible for their success, most preservice teachers, both at the beginning and end of their programs, believed learners are primarily responsible for their failures, most frequently citing student indifference as the culprit.
- Although most attributed student success to the students themselves, most teachers in the induction program, both at the beginning and end of their program, believed that the teacher rather than the student is principally responsible for student failure. The factor most often cited by these teachers as the source of student failure is the teacher's failure to consider uniqueness (46 percent at end of program).
- Most alternate route teachers began their programs believing that student factors are primarily responsible for student failure. By the end of the program, significantly more of the teachers in these programs believed this to be true (68 percent), many (29 percent) citing, in particular, student home background as the source of student failure.
- Like their counterparts in the alternate route programs, significant number of teachers in the inservice programs also changed their beliefs about the source of student failure. The direction of the change, however, was the opposite that experienced by many alternate route teachers: Whereas only 31 percent chose teacher factors as the primary source of failure at the beginning of their programs, nearly half did so at the end of the program.

In sum

- Most teachers in the preservice, induction, and alternate route programs in our sample began their programs believing that students, not teachers, are primarily responsible for both their success and failure in school.
- Teachers in the induction program showed a different pattern: Although they seemed to agree with other teachers in our sample that students' are primarily responsible for their success, most attributed students' school failure to teachers, particularly to teachers' failure to consider student uniqueness.
- Significantly more alternate route teachers cited students' home background as the source of student failure; more inservice teachers cited teaching methods and teacher indifference.

To What Degree Do Teachers Believe Student Ability to Be Inherent and to What Degree Do They Believe Ability Is a Matter of Opportunity?

Teachers' dispositions to take responsibility for ensuring that all children have the opportunity to learn is, logically, linked to their beliefs about academic ability. Teachers who believe, for instance, that "to be good at math, you need to have a kind of 'mathematical mind,'" may be more inclined to give up earlier on helping students who seem to have difficulties in mathematics. If a student doesn't have what it takes in a specific

subject matter, why push it? Why not focus on something for which the student appears to have an aptitude? Historically, girls and children of color have achieved below the level of white boys and have been less likely to pursue more advanced mathematics. However, as with the issue of school success and failure, teachers who believe that ability in mathematics and writing are largely inherent may also view this as a challenge to which they should rise rather than a reason to stop trying.

- Among preservice teachers, nearly half of those in our sample agreed that "to be good in mathematics, you need to have a kind of 'mathematical mind.'" By the end of their programs, however, only 27 percent agreed with the statement.
- Although fewer teachers in the induction program initially agreed with the statement (33 percent), they exhibit a similar pattern of change: Only 12 percent "slightly" agreed with the statement at the end of the their program.
- The sample of inservice teachers showed no significant change: About 35 percent agreed with the statement at the beginning of their programs and 27 percent agreed at the end.
- Responses to a related item—"I don't have the kind of mind needed to do advanced mathematics"—reveal a similar pattern: Teachers in the preservice and induction programs in our sample appeared to become over time less convinced that they don't have the right kind of mind for mathematics.
- Perhaps because many of them were mathematics majors in college, few alternate route teachers agreed that they don't have the right kind of mind for mathematics. Many inservice teachers, on the other hand, believed, both at the beginning (40 percent) and the end of their programs (32 percent), that they don't have "mathematical minds."

In sum

- A significant number of teachers—as many as half—in all the types of programs in our sample believe that "to be good in mathematics, you need to have a kind of 'mathematical mind.'"
- Preservice and inservice programs in our sample appear to have some effect on how teachers think about this issue: A significant number of teachers in both types of programs appear to change their beliefs about the issue of the inherency of mathematical ability.
- These data seem to suggest that a significant proportion of the teachers in our sample believe that mathematical ability is something learners either have or don't have.

To What Degree Do Teachers Believe Learners Should Be Grouped by Ability or Tracked?

Recent research shows that children from working class and minority families are more likely to be placed in low-level groups and nonacademic tracks in high school. This same research also shows that children in such groups are provided fewer chances to learn knowledge and skills that will help them succeed in school; that is, once placed in a low-ability track, students are unlikely to learn important content that might help them move out of that track. Given these findings, we wondered about the extent to which teachers' views of ability group and tracking may influence the opportunities they create for historically underserved children to learn.

Because of the difficulty we had in interpreting the data we collected in the first administration of the questionnaire, we asked teachers about their views of ability grouping and tracking on the interview. Teachers' responses revealed that the wording of the item on the questionnaire ("Teachers should avoid grouping . . .") caused some confusion. When we finish analyzing these interview data, we will have both a better sense of what teachers think as well as the validity of the data we gathered with the questionnaire. Given these problems, the following statements are offered even more tentatively than others in this section of the report.

- Teachers in our sample appear more or less evenly split on the wisdom of grouping learners by ability.
- Significant proportions of preservice (45 percent) and alternate route (61 percent) teachers in our sample agreed, at the end of their programs, that students should be tracked.
- Most teachers in the induction program began their program disagreeing with tracking (63 percent) and became significantly more negative about tracking by the end of their program: Whereas 25 percent strongly disagreed with tracking when they started the program, 43 percent did do by the end.
- In addition, a significant proportion of teachers were uncertain about the issues—for instance, 18 percent of those in the preservice programs indicated they were not sure about ability grouping and 42 percent of those in the inservice sample indicated similar uncertainty about tracking.
- Interview data on this issue revealed that even some of the teachers who thought that teachers should avoid ability grouping and tracking seemed to assume that they too would group children by ability and go along with tracking if that was the policy of the school in which they taught.

To What Degree Do Teachers Believe All Students Should Be Held to the Same Standards?

Parents of children of color have become increasingly concerned in recent years about the expectations that teachers, most of whom are white, convey to their children. At the same time, many teachers seem to believe that part of being sensitive and responsive to children is individualizing instruction to address the needs they believe particular students have. Individualizing instruction appears to include adapting expectations to individual

children. To teachers, however, this may or may not constitute "lowering" expectations but rather tailoring them.

- Most teachers (60 percent and 57 percent, respectively) in the preservice and alternate route programs in our sample began their programs believing that "teachers should use the same standards in evaluating the work of all students in the class."
- The proportion of teachers in these programs who had changed their minds about this issue by the end of their programs was not significant.
- In contrast, nearly three-quarters of the teachers in the induction and inservice programs disagreed, when they started their programs, that teachers should apply the same standards to all students.
- Only in the induction program did a significant proportion of teachers appear to change their minds: An additional 10 percent—for a total of 83 percent—of the induction teachers came to disagree that teachers should apply uniform standards to all students.

In sum

- Of all the programs we studied, none encourages teachers to attend to learners' background more than does the induction program.
- Data from one of the scenarios on the interview lend additional evidence to the suggestion that teachers pay scant attention to what particular knowledge and skills students learn from different activities and materials, that assigning different activities may mean creating differential access to critical knowledge.
- Although our data do not allow us to answer definitively the questions that we have raised above, they suggest that we need to investigate further teachers' apparent penchant for individualization and "tailored' standards as ways of addressing learner diversity.

Conclusion

Despite the difficulties we had developing instruments that we felt registered valid information about teachers' knowledge of teaching diverse learners subject matter, analyses of the TELT data raise a number of questions both about how researchers collect data and about how teacher educators are preparing teachers to work with diverse learners. Gaining a greater understanding of the rationale for teachers' beliefs and commitments toward teaching learners who are racially, socially, linguistically, and culturally different from themselves may require greater attention to teachers' biographies. What have been their prior experiences with people different from themselves, particularly in school? How do teachers' beliefs and commitments influence the understandings they develop about diverse learners as they teach?

In our study, teachers at all stages of development appear to think of differences primarily in individual, psychological terms. To them, being fair means ignoring categorical differences, a reasonable position in a society that, to varying degrees over time, has aspired

to being egalitarian, color-blind, and gender neutral. This position, however, ignores the fact that poor children, those of color, and, in some subjects, girls have historically been denied opportunities to learn critical knowledge and skills in school. Rather than acknowledging teachers' responsibility in contributing to such inequities, teachers in our sample usually believe that students' background, ability, and attitude—not teachers' attitudes or pedagogical methods—are the principal determinants of students' success and failure.

Most of the preservice teachers in our sample seem to think about learner diversity in the classroom as a problem rather than a phenomenon. As a problem, differences among learners have, for many of the teachers in our sample, a solution ready at hand: individualizing. Believing individualized instruction to be the answer to differences in learners' knowledge, skill, and attitude, most teachers in the study appeared uncritical about what students might learn from various activities. The only criterion most teachers in our sample apply to the individual tasks teachers assign is whether or not the task will appeal to the student, not what the student might learn from the activity. Finally, most of the teachers appear to assume that student resistance is principally a misunderstanding: If students are made to understand that the teacher wants them to participate in a class, such information would overcome their resistance.

The programs in our sample varied considerably in the attention they paid to issues of diverse learners. Some devoted separate classes or workshops to the issues; others included the issues as part of a psychology course. The programs appear to define the issue of teaching diverse learners as one that can be addressed largely through providing teachers with more information about learners from various groups and about techniques and activities designed to address prejudice or raise the prominence of historically underrepresented groups in the curriculum. Two of the programs appeared to attempt to help teachers think about issues of language, racial, social, and cultural differences in the context of their classrooms and their classroom practices.

One of these programs, an induction program for first-year teachers, differed in other ways from the remaining programs in our sample. At the outset of their program, teachers in this program, as a group, responded differently to the interview and questionnaire items designed to tap their views of teaching diverse learners. Most of them, for instance, already thought that teachers are primarily responsible for students' failures in school. The program seems to have strengthened their convictions and heightened in their minds the salience of attending to students' uniqueness rather than to have changed the direction of their thinking. Similarly, while most began believing that mathematical performance was not principally a function of inherent ability, they were even more convinced of this by the end of the program. Another example, whose implications are unusually difficult to fathom, is that teachers in the induction program appeared to become more convinced that teachers should not use the same standards in evaluating the work of all students.

This is an example of data that is difficult to interpret. Most of the teachers in our sample moved, from the beginning to the end of their programs, in the direction of believing that teachers should apply different standards in evaluating the work of different students. On the one hand, such a change in teachers' beliefs could be regarded as problematic: Holding historically underrepresented children to lower standards merely continues to deny these children access to the knowledge critical to success in school and beyond. Attending

to differences in children's understanding, explicitly and directly trying to build students' self-esteem, and figuring out rewards that are appropriate and motivating for particular children is, on the other hand, a theme that recurs in various multicultural courses and workshops. So, does this trend we found in the data promise better opportunities to learn for these children or just more of the same?

The induction program, which seems most successful in influencing teachers' thinking about issues around teaching diverse learners, may have been influential precisely because teachers were predisposed at the outset to think in the direction the program seemed to be directing them. In keeping with a Chinese adage, program personnel seemed to "ride the horse in the direction it was already headed." An equally important factor contributing to the program's apparent influence may be, however, that the issues of differences among learners were examined within the context of the teachers' own practice and their classrooms. The availability of the clinical teachers to the participants and the opportunity to raise issues arising from their practice in various program forums presented teachers with chances to talk and think about their practice with others who faced or had faced similar situations and dilemmas.

This can be contrasted with the experience teachers had in all but one of the other programs. In these programs, issues of differences among learners and the implications of these differences for teaching and learning seem to have been addressed outside of a specific context—and particularly, outside of the context of the teachers' classrooms and practice. Teachers in these programs were not afforded, in the program, the opportunity to examine, discuss, and think about issues of learner differences in the context of their own practice. By and large, the issue remained abstract, decoupled from practice and, consequently, from the other questions and issues teachers must consider simultaneously.

Although we do not have evidence of substantial changes along this dimension of teacher knowledge among teachers in our sample, the results are not totally bleak or unedifying. As the evidence from the induction program shows, addressing issues of learner diversity in the context of teachers' classrooms and their practice may be a promising approach. On the other hand, much of what currently is purveyed under the rubric of multicultural education appears largely ineffective.

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CHAPTER 5

VIEWS ABOUT LEARNING TO TEACH

The phrase "learning to teach" rolls quickly off the tongue giving the impression that it is a simple, straightforward process. In fact, we do not have well developed theories about how teachers learn to teach. Nor is there consensus about what goes into the "making of a teacher." There are, of course, common sense theories: "Anyone can teach." "If you know your subjects, you can teach them." "Teachers are born not made." But these assertions find little support in the field or in the research literature.

For a long time people expected research on teaching to provide guidance in designing programs for teachers. But knowing how experienced teachers think or what they know and do is not the same as knowing how they learned to teach and what contributed to that learning. Researchers, policymakers and teacher educators have been slow to recognize that knowledge about teacher learning would be enormously helpful in designing effective teacher education programs and policies.

At the same time, efforts to improve teaching and teacher education rest on assumptions about learning to teach. For example, policies that limit professional requirements for undergraduates and increase academic requirements rest on the assumption that liberal arts courses strengthen teachers' subject matter background. And policies that mandate assessment of beginning teachers without also providing assistance rest on the assumption that learning to teach is something you finish before beginning to teach.

How We Thought About "Learning to Teach"

In the TELT study, we thought about "learning to teach" as (a) a domain of teacher beliefs (b) a lens for studying programs and (c) a perspective shaping the research design. We wanted to understand how teachers think about learning to teach and what conceptions of learning to teach inform different teacher education programs. We hoped that these explorations would lead to better ways of conceptualizing, studying and supporting teacher learning.

As a Domain of Teacher Belief

Lortie's (1975) insights and analyses of the "apprenticeship of observation" have become the received wisdom in the field, demolishing the notion that future teachers enter programs with a blank mind. While classroom teachers have been urged to take account of their pupils' conceptions in planning instruction, the curriculum of teacher education pays little heed to what teachers-to-be know and believe. A more specific understanding of the ideas, knowledge, expectations that teachers come with can help teacher educators plan more effective programs at all career stages. This includes beliefs about learning to teach.

We had two reasons for studying teachers' beliefs about learning to teach. First, such beliefs would provide further evidence of teachers' views of teaching. Second, such beliefs could help explain teachers' openness and receptivity to different kinds of knowledge and sources of learning.

Teachers who find little value in knowing how mathematicians or writers work probably have a different view of teaching from those who feel that such knowledge will help them in teaching. Teachers who relish opportunities to gain more subject matter knowledge probably have a different view of teaching from those who ask for management strategies. Thus knowing how teachers at different stages think about learning to teach adds further insight into how they conceptualize their role.

Similarly teachers' views about learning to teach may reveal the relative importance they place on different kinds of knowledge and different learning opportunities. Suppose teachers believe that everything they really need to know about teaching will come from experience. This could easily affect their stance toward education courses. Or suppose teachers assume that they already have adequate subject matter knowledge and that whatever they do not know can be found in the teacher's guide. Such beliefs would not dispose teachers to consider liberal arts courses as part of their preparation for teaching.

As a Lens for Studying Programs

By design or default, teacher education programs reflect assumptions about what teachers need to know and how they can be helped to learn that. In using "learning to teach" as a lens for studying programs, we were interested in views of learning to teach embodied in the programs' aims and structure as well as the opportunities to learn available to teachers.

Knowing what programs try to teach and how they go about it can help in explaining their impact. Given our focus on learning to teach mathematics and writing, we can begin to consider the kinds of learning opportunities that lead teachers to adopt particular approaches to teaching these subjects.

Knowing how programs at the same and at different career stages define their responsibility vis a vis learning to teach can stimulate thinking about what goes into the making of a teacher and what contribution teacher education can and should make at the preservice, induction and inservice levels. What does "preparation for teaching" mean in the context of different preservice and alternate route programs? Do preservice programs aim to prepare people for teaching or for beginning to learn teaching on-the-job? The same kinds of questions can be asked about induction and inservice programs. Answers to such questions can begin to inform thinking about the order of professional learning and the central tasks of teacher education at different career stages.

As a Perspective Shaping the Research

In the TELT study, we assumed that teachers learn to teach unevenly, acquiring knowledge, skills and dispositions from various sources over time. For instance, prospective teachers may gain formal knowledge of learners and learning from their education courses but gain more grounded insights from actual teaching experience. And experienced teachers may change their conceptions of mathematics and how it should be taught through their involvement in a powerful inservice activity. In our research, we wanted to know what teachers at different career stages were learning about the teaching of math and writing to

diverse learners from their participation in liberal arts courses, education courses, summer institutes an study groups. We also wanted to know what they learned from classroom experience with and without guidance. The longitudinal research design enabled us to track changes in teachers' knowledge, skills and dispositions over time and to link those changes to different types of formal and informal learning opportunities.

At the same time, we recognized that, in teaching, teachers must call on different kinds of knowledge in deciding what to do in particular situations. It follows that learning to teach means learning to integrate different kinds of knowledge in reasoning about instructional situations. In developing our interview protocol, we devised scenarios around common classroom situations that arise in teaching mathematics and writing and asked prospective and practicing teachers to respond to those scenarios. For example, we asked teachers to examine two students' papers written for a common assignment. The teachers' evaluations of those papers reveal what they focus on and what they believe to be important in learning to writing and in responding to pupils' work. By looking at their reasoning across several scenarios, we sought patterns in thinking and understanding. By recording teachers' responses to scenarios at three points in time—at the beginning and end of their program and a year later—we hoped to capture changes in their pedagogical reasoning.

Program Findings Related To Learning To Teach

We assumed that different programs would reflect different arguments about what teachers need to know, what teaching is like, how teaching is learned. By looking at aims and structure, curriculum and pedagogy, we sought to undercover the visions of teacher knowledge, teaching, and learning to teach that animate and orient different approaches and alternatives to teacher education. We also wanted to connect these features of programs with their effects on teachers' knowledge, skills, and dispositions. Below we discuss briefly some findings related to the character and impact of different approaches and alternatives.

You Can't Judge a Program By Its Structure

While public debate often focuses on the relative merits of different forms of teacher education—four-year, five-year, fifth-year programs—such information may be misleading. Moreover, arguments for or against particular types of programs may not hold up in the face of information about what the program is actually like. We discovered some surprises in our program studies.

The integrated BA/MA program chosen to represent a five-year program really did not function that way for many students. For one thing, students often transferred in as juniors after completing their general education in a junior college. Moreover a significant number of seniors did not qualify for graduate school, thus eliminating the possibility of earning a masters degree. Only a small percentage of students actually experienced a five-year, coordinated sequence.

Ironically, the one-year, teacher induction program provided a better example of a five-year, integrated program. Most of the graduate interns came from the university's preservice program. As a result, the induction program could concentrate on helping them

put into practice ideas and ideals about good teaching that were promoted in their preservice preparation. In many ways this program came to represent for us an ideal structure.

A third example of how structural labels can mislead comes from our study of alternative route programs. We were surprised to discover that, in some fundamental ways, alternate route programs are not so different from conventional preservice programs. For one thing, the topics treated in the formal instructional components were very similar to the topics typically associated with a traditional preservice curriculum. Moreover, the mentor teachers, like cooperating teachers at the preservice level, had little or no knowledge of what novices were learning in these components.

Defining Responsibilities for Learning to Teach

We were interested to learn how different programs at the same and different career stages defined their responsibilities for learning to teach. To what extent did programs identify essential knowledge for teaching? To what extent did they assist teachers in learning to integrate different kinds of knowledge in reasoning about their practice?

Preservice. At the preservice level, we found that programs held rather different purposes with respect to teacher preparation. This came out in two ways. For one thing, programs differed in their commitment to help candidates integrate different kinds of knowledge. Secondly, we found differences in the kind of knowledge that programs deemed central to teaching. Together these differences suggest that there is no consensus about what it means to "prepare" someone for teaching.

One of the preservice programs we studied relied entirely on students to translate their disciplinary knowledge into appropriate curriculum and instruction. In their interviews, faculty acknowledge that preservice candidates must make the connections and applications on their own. One person stated the position most clearly: "Learning how to teach, probably more than anything else they've done at [our institution], is up to them." Lack of support in making subject-specific translations is reflected in the fact that all secondary candidates take the same generic methods course regardless of their teaching subject. While the program staff believe that pedagogy is subject-specific, it lacks the resources to provide such instruction. Even so, faculty believe that students cannot really learn to teach "until they start doing it." Instead of preparing people to teach, this program seems to prepare its graduates to learn teaching on the job.

Another program takes a different stand on the issue of integration and preparation. This program provides an integrated curriculum because that is the way teachers are supposed to teach. Methods courses are offered in blocks: social studies with child development, science with language arts. Students also spend a great deal of time in classrooms where they get help taking ideas encountered at the university and applying them in practice. The strong emphasis on practice means that students really feel "ready" to teach when they complete their preservice work. This fits with the stated goals of the faculty.

In terms of knowledge for teaching, the more striking finding is the absence of consensus about what prospective teachers should be taught. We found relatively few cases

where programs clearly identified some body of knowledge as essential. In our exploratory visits, we encountered one graduate program which emphasizes knowledge of child development as an integrating core. Exemplary in its conceptual coherence, this program is built around the application of development knowledge to teaching. In our regular sample, two of the five preservice programs had clearly identified "knowledge bases" but they differed. One program endorsed teaching for understanding as its central goal. Students encountered an amalgam of epistemology, constructivist psychology, and curriculum theory to support such an orientation to the teaching of academic subjects. The other program introduced students to teacher-effectiveness research since this provides the basis for the state-wide performance assessment.

First-year teachers. The programs serving first-year teachers in our sample serve quite different clienteles. The induction program provides support and assistance to beginning teachers who have completed a preservice program. The alternate route programs provide support and assistance to college graduates with no professional preparation. Not surprisingly, the programs define learning to teaching in quite different ways.

The induction program which is jointly sponsored by the university and school district emphasizes professional growth through reflection on teaching. The central task of the program is helping novices translate beliefs and understandings into workable practices. Most of the interns come from the same preservice program where they internalized a shared view of good teaching. Thus the induction program concentrates on helping them design and enact practices that match their beliefs. Support teachers focus novices' attention on pupils' thinking and encourage novices to articulate the rationale behind their practices.

The alternate route programs also provide support and assistance to beginning teachers, but the emphasis is on learning the ropes and fitting in. The mentor teacher component where novices actually learn the practice of teaching is disconnected from the teacher trainee program where interns learn about teaching. Mentors concentrate on passing on advice and strategies based on their teaching experience. There is little attention to novices' thinking or the justification of good practice.

Inservice. Both inservice programs adopted a focus that we typically associated with preservice preparation--helping teachers learn to enact a new definition of their role. Despite the fact that these programs were grounded in particular subject matters, neither gave primary attention to teachers' subject matter knowledge. Both concentrated instead on helping experienced teachers transform their role.

The inservice program on teaching mathematics emphasized learning as a constructivist activity. A central ingredient in transforming mathematics instruction is providing teachers with firsthand experience constructing mathematical knowledge. The summer institute seemed directed toward altering teachers' understanding of learning and their image of what good mathematics teaching should be like. Teachers in the local area had the opportunity to work with staff during the school year. Classroom follow-up support and guidance enabled these teachers to experiment with new approaches to mathematics teaching and learning in their own classroom.

The inservice program on writing also focuses on transforming the teacher's role as the most effective way to transform the teaching of writing. Knowledge about how writers write is seen as essential if teachers are going to create authentic conditions for meaningful writing in school. The Writing Project also provides trainers to work with groups of teachers in their classrooms during the year. Here trainers demonstrate how to set up a writer's workshop, model ways to present minilessons and talk with pupils about their writing, and coach teachers as they experiment with a new teacher role.

Teacher Education Can Make a Difference

Compared with other influences on learning to teach, teacher education is generally regarded as a weak intervention. At the preservice level, this often means that programs do not challenge the "apprenticeship of observation"—the years of teacher-watching that shape prospective teachers' views of teaching. As a result, teachers often leave preservice preparation with their initial views intact. They tend to teach as they were taught rather than as they were enjoined to teach by teacher educators. At the inservice level, the argument often focuses on the socializing impact of school culture. Left to sink or swim on their own, novices understandably fall back on early models or do what they see others around them doing. Experienced teachers, cynical about most inservice programs and isolated from their colleagues, also tend to maintain rather than question conventional practice.

But we discovered teacher education programs at each career stage that were powerful enough to influence teachers' beliefs and practices. In each case, the program managed to move teachers beyond conventional teaching to new practices that go against the grain of conventional teaching. By studying the learning opportunities that these programs provided, we gain insights into the conditions that enable teachers to change their practice in fundamental ways.

Altering beliefs of teacher candidates. One preservice program managed to alter prospective teachers' knowledge and beliefs about good mathematics teaching through an intense and innovative three-course mathematics sequence followed by a math methods course. In these courses, students had opportunities to experience the learning of mathematics in ways that differ radically from their own encounters with mathematics as elementary and high school pupils. The emphasis was on problem solving through the creation of a mathematics learning community. Students also saw demonstrations of this kind of mathematics teaching live and on videotape.

During student teaching, candidates had support from university supervisors and mentor teachers to try out this new approach to teaching mathematics. This gave them a chance to practice what they had come to believe represented a better approach to mathematics teaching and learning than the one they had experienced in their own schooling. As beginning teachers, however, program graduates experienced various constraints that limited their ability to teach mathematics in nontraditional ways. These included limitations in their knowledge of mathematics, lack of time and materials, and resistance from parents and administrators (Wilcox, Schram, Lappan, and Lanier, 1991).

Helping novices put ideas into practice. We have already described the professionally oriented induction program. Here we highlight the role of the program in helping novices put into practices ideas and ideals they had learned about in their preservice program. Because most of the interns had already adopted the view of good teaching promoted by the preservice program, the induction program was able to concentrate on helping novices learn to translate ideas into concrete practices. On-site support and guidance from experienced teachers who shared that view enabled novices to evolve a practice consistent with their beliefs. The only intern who dramatically changed her beliefs about teaching and learning came from a different preservice program. The other interns basically maintained their beliefs while developing their practice.

Altering experienced teachers' beliefs and practices. Finally, both inservice programs were successful in altering experienced teachers beliefs and practices. Each program provided a summer component where teachers experienced firsthand the kind of teaching they were supposed to adopt and where they learned about the rationale for these innovative practices. And each program provided classroom follow-up. Individual staff worked with teachers in their classrooms helping them learn to put into practice these new approaches to the teaching of math and writing.

During the summer, teachers in the SummerMath program, worked in small groups solving mathematics problems much as their pupils might. This provided an opportunity to experience a new way of learning mathematics. They also observed demonstrations with children which made visible and concrete a new kind of teacher role, one in which the teacher questioned and probed student thinking rather than praised student effort. During the school year, staff members worked individually with teachers in their classrooms, helping them implement new kinds of mathematics teaching.

In the inservice program on writing, teachers also participated in a summer institute where they learned about the rationale of writer's workshop and talked about writing—their own and others. During the school year, trainers worked in schools with groups of teachers, demonstrating how to set up a writer's workshop, modeling ways of presenting minilessons and talking with students about their writing, and coaching teachers as they experimented with these new structures and approaches. Teachers also attended Saturday workshops where trainers discussed various topics and issues and they continued talking with colleagues at their school who were also engaged in implementing writer's workshop. The availability of ongoing support and the chance to talk about their experiences with other teachers were critical in helping teachers to implement and refine their writing workshop.

What do these programs have in common? What learning opportunities seem to be associated with fundamental changes in teachers' beliefs and/or their practices? From our program studies, we have identified four conditions that seem necessary if teacher educators are serious about helping teachers adopt innovative practices. First, teachers need a chance to consider why the new practices are better than more conventional approaches. Second, they must see examples of such practices. Third, it helps if they can experience such practices firsthand as learners. Fourth, they need on-site support and assistance in learning to put new practices in place. These conditions inform central hypotheses that we are testing in our new Center for Research on Teacher Learning.

Teacher's Beliefs About Learning To Teach

There is now agreement that new knowledge is influenced by old knowledge, that existing conceptions and expectations significantly shape learning. It follows that how teachers think about learning to teach will influence their openness and receptivity to different kinds of knowledge and sources of learning. For instance, will preservice programs with a strong subject matter emphasis have the same impact on students who enter programs believing that you learn about teaching in the classroom as they will on students who believe that knowing their subject matter thoroughly is the key to learning to teach?

The issue of where and how teachers believe they learn what they need to know also tells us about what they think the substance is of what they need to know. For instance, one item in the questionnaire asks: "If a student asks a question in math, the teacher should know the answer." On one level, responses to this question tell us about teachers' perceptions of their role; that is, learning to teach means learning everything you need to know about math to answer any question a pupil may have. On another level, responses tell us how teachers think about what learning mathematics for teaching means. If teachers believe that mathematics is a body of rules, procedures, and facts, that can be learned once and for all, they are more likely to agree with this statement. In contrast, if they believe that mathematics is a field in which invention, discovery, interpretation, and fooling around with ideas and approaches play a major role, they will probably disagree.

We have only begun to analyze teachers' beliefs about learning to teach and whether and how they change as teachers participate in different teacher education programs and move into teaching. We have not yet studied the impact of particular programs on this domain of teacher belief. Still, we have discovered general patterns across different career stages that suggest some of the challenges teacher educators face if they want to transform teachers' beliefs about learning to teach. We briefly describe findings based on an analysis of questionnaire data.

The Centrality of Experience

Teachers at all career stages value firsthand experience as the major source of knowledge and a means of learning to teach. This comes through strongly in the pattern of responses to questionnaire items about what teachers need to know to teach math and writing effectively and where they can learn that. (See Figures 1 and 2).

In the questionnaire, we presented a list of activities asking respondents to indicate how helpful each would be in learning to teach. The choices included opportunities to gain subject matter knowledge, practical knowledge, teaching skill, knowledge of learners, knowledge about how expert teachers work. Activities included taking math and writing courses, taking courses in teaching math and writing, observing and talking with other teachers, studying samples of student work, and interviewing mathematicians and writers.

The highest percentage of teachers in all groups—prospective, beginning, and experienced teachers—rated "getting more teaching experience"—as most helpful. This was true for teaching mathematics as well as for teaching writing. Next came opportunities close to teaching such as talking to other teachers and observing and being observed. Learning

what experts such as mathematicians and writers do garnered the lowest percentages. Whereas 81 percent of the experienced teachers in our sample valued getting more experience teaching math, only 18 percent saw any value in learning about the history of mathematics.

Some interesting subject matter differences surfaced in teachers' views about what knowledge is most important in learning to teach math and writing. Significantly more teachers at each career stage were interested in how writers write than in how mathematicians do their work. This suggests that conventional views of mathematics are more deeply entrenched than conventional views of writing.

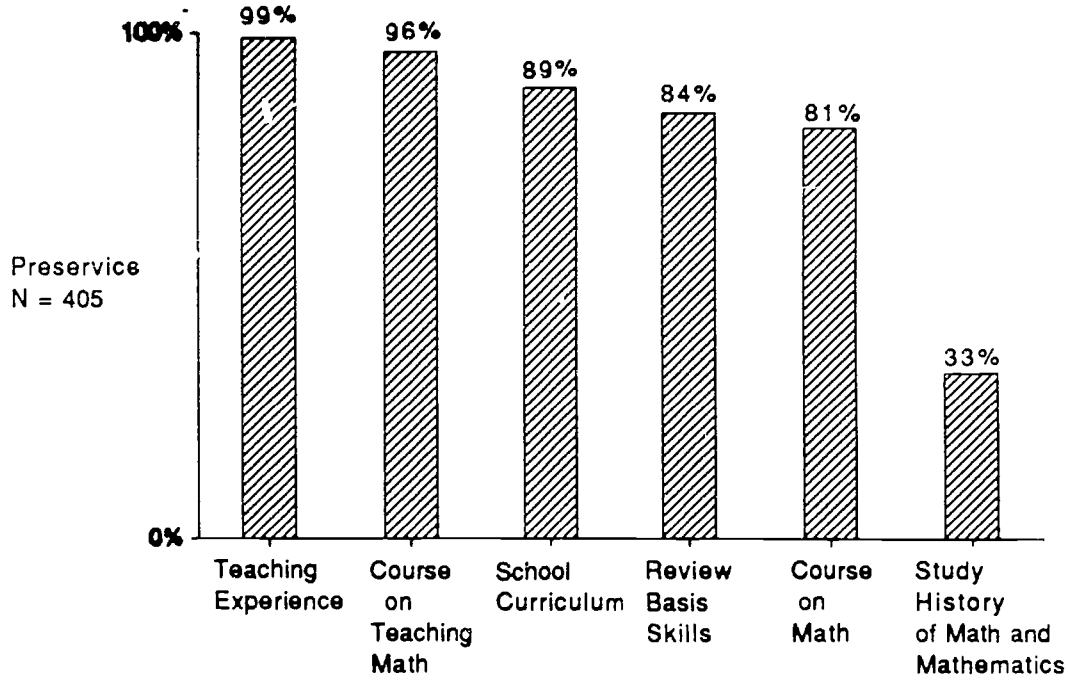
Beliefs about learning to teach math. Opportunities to learn that are closest to the classroom received the highest endorsement. The general progression as reflected in the two figures that follow goes from getting experience to taking a course on teaching math to taking a math course to learning about what mathematicians do. The same trend is apparent in responses to writing items. This points to a related trend—the closer the activity to actual teaching, the more highly teachers value it.

Within each subject area there are some interesting differences across the career stages. More prospective teachers (84 percent) and beginning teachers (79 percent) feel the need to review basic skills such as factoring and operations with fractions. This is less important to alternate route candidates (52 percent) who presumably think they know their subject matter and to experienced teachers (51 percent) who may believe they already know basic math from teaching it. The history of mathematics attracts little interest across the board. Most interested are alternate route candidates (40 percent) who presumably have the strongest background in mathematics already. Experienced teachers reject such knowledge as relevant to teaching. Only 18 percent agree that it is valuable.

Beliefs about learning to teach writing. In terms of learning to teach writing, the responses show the same general trends. The closer the activity to actual teaching, the more it is valued by teachers at all levels. Moreover direct or firsthand teaching is experience is seen as more helpful than experiences that are further removed from actual classroom practice.

We already noted that teachers at all levels were relatively uninterested in learning more about what mathematicians do. This was not the case in writing where significantly larger numbers of teachers at every career stages indicated interest in learning about how writers write. Most interested are experienced teachers (81 percent); next are beginning teachers (alternate route 80 percent; induction group 70 percent); the lowest percentage (65 percent) comes from preservice teachers who may not yet be bitten by the "process" writing bug. Apparently knowledge about the process of writing seems more relevant to the job of teaching writing in school.

More alternate route candidates (70 percent) think teachers must write in order to teach writing; however, they do not think that teachers have to be good writers to be good teachers of writing. Grammar stands out as important knowledge for teaching writing, at least for preservice (75 percent) and alternate route (80 percent) candidates. Eighty percent of the alternate route candidates and 75 percent of the preservice candidates strongly agree



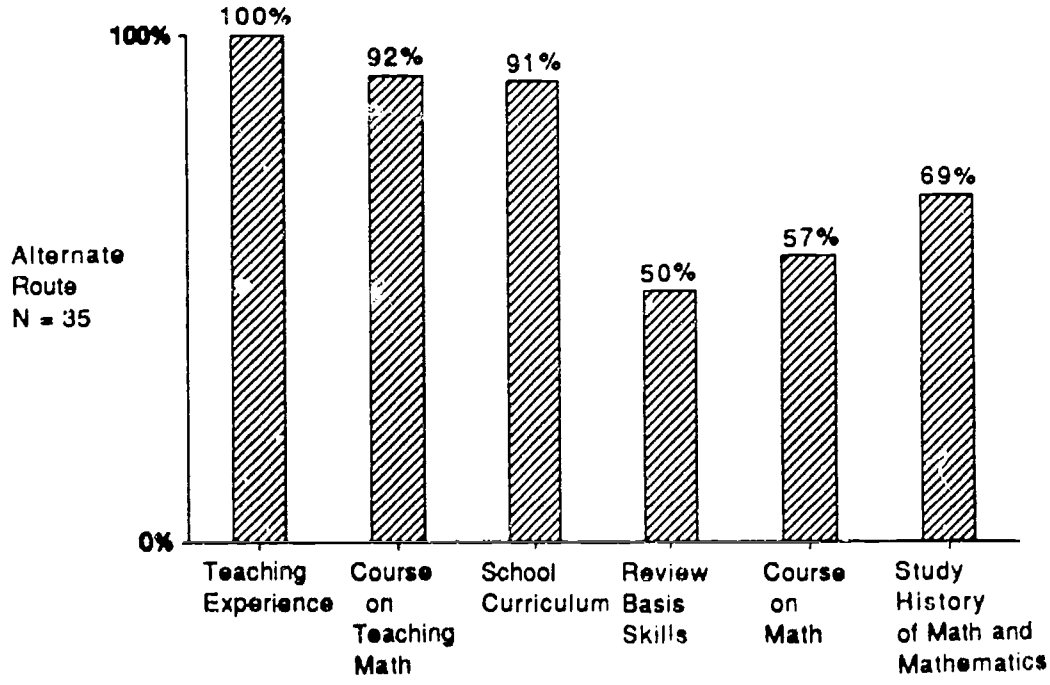
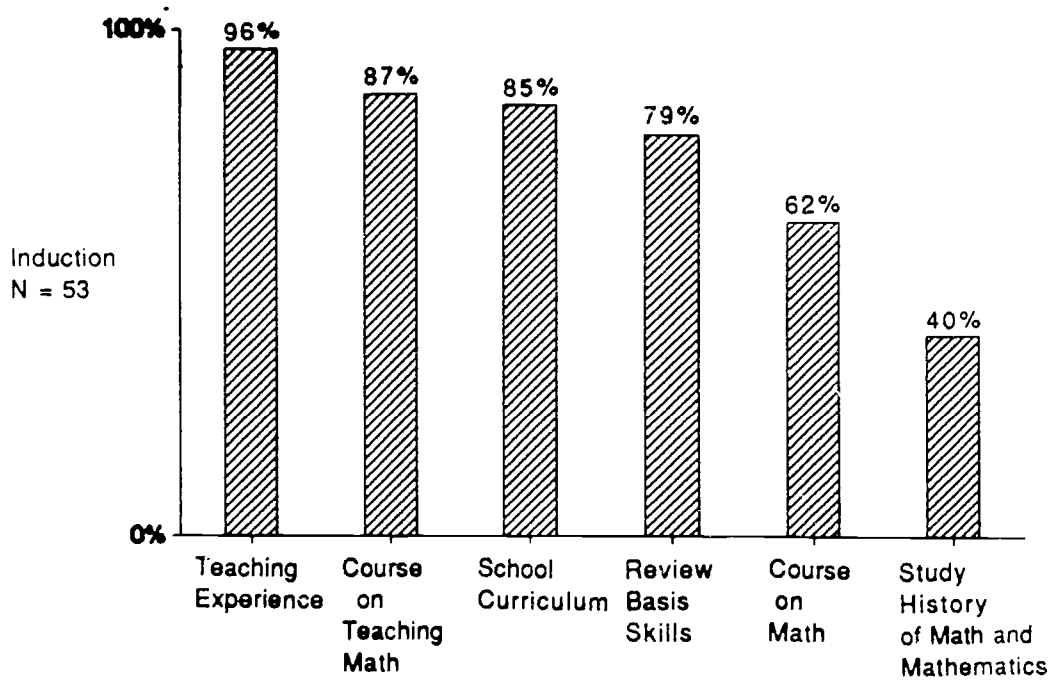
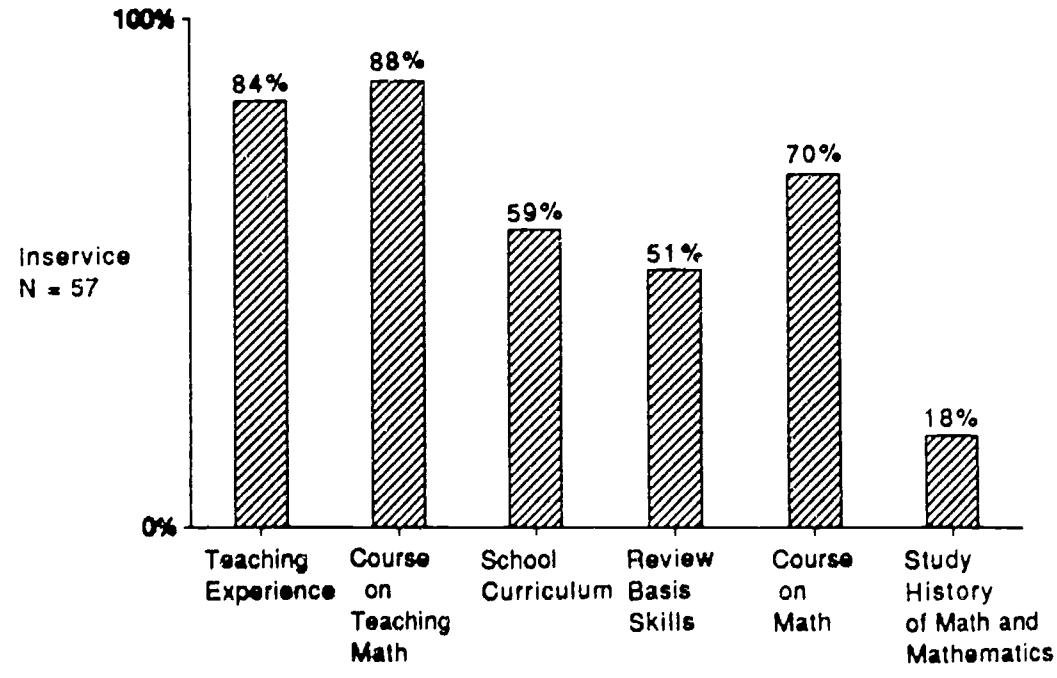


Figure 1. Prospective and practicing teachers' beliefs about sources of knowledge in learning to teach math.





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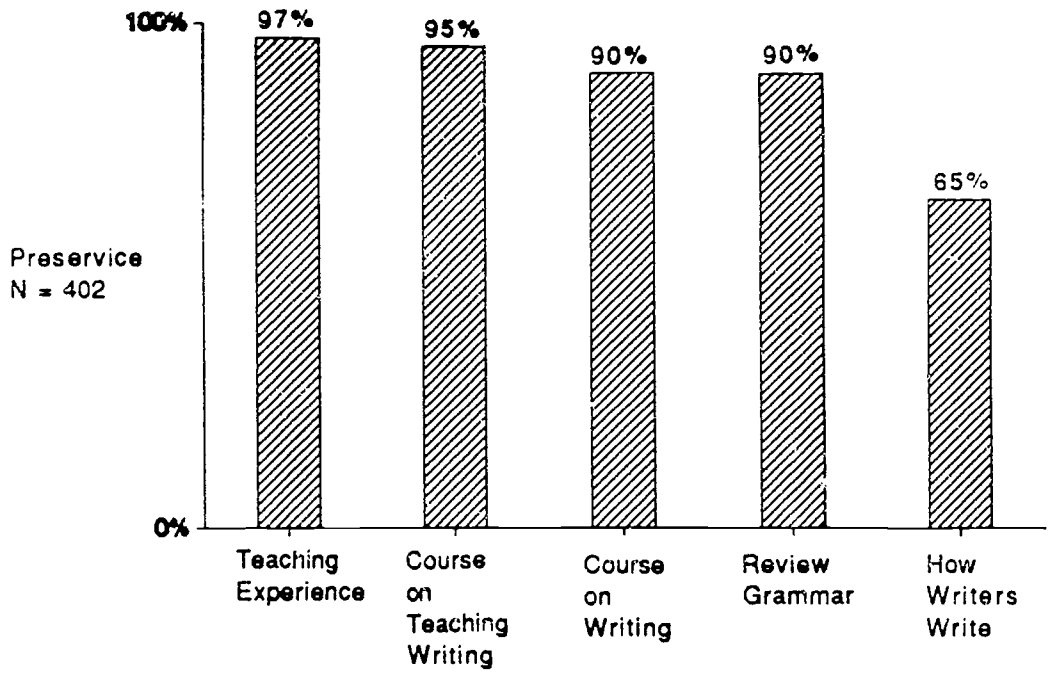


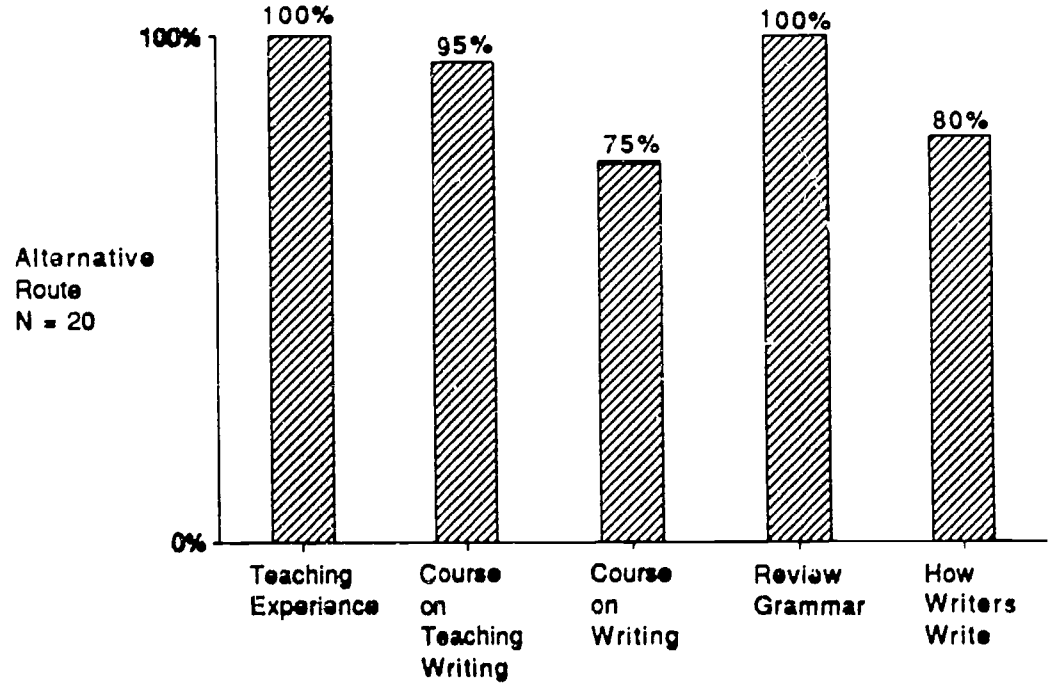
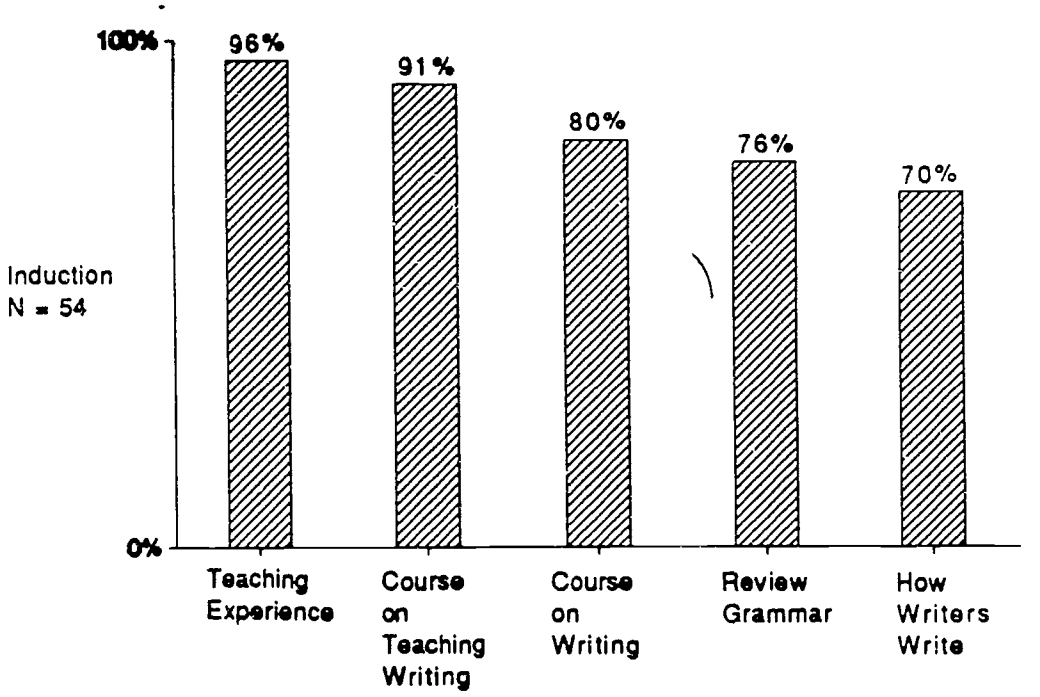


Figure 2. Prospectives and practicing teachers' beliefs about sources of knowledge in learning to teach writing.



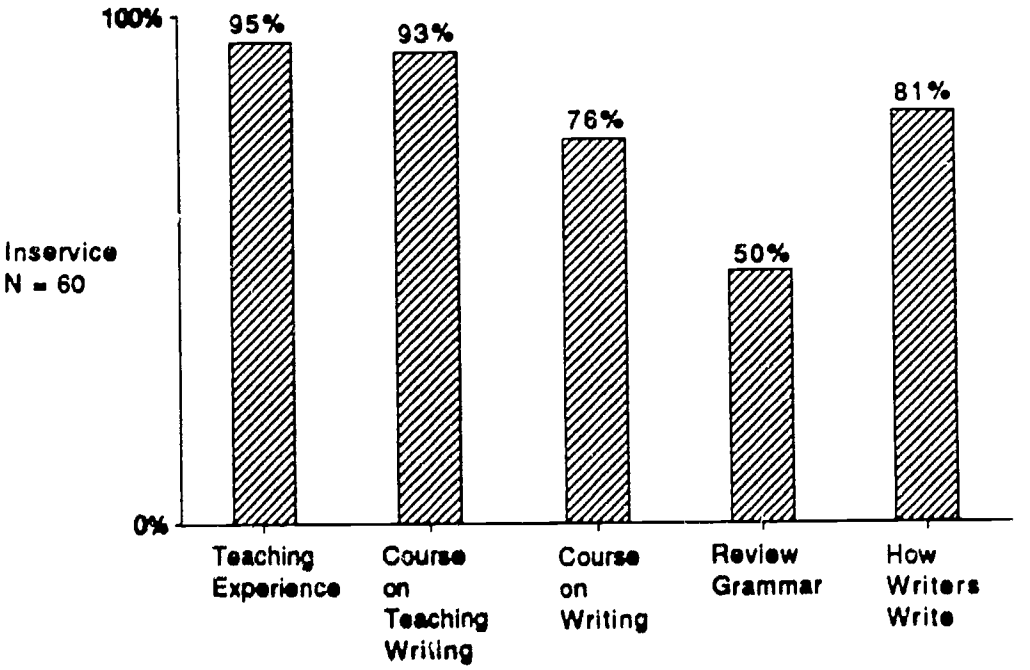


Figure 2 continued

that teachers need to know parts of speech and terms to describe writing conventions. By contrast, only 35 percent of the interns and 43 percent of the inservice teachers thought such knowledge relevant.

Finally, about 75 percent of all teachers at every career stage agreed with the statement: "Since there is no one best way of teaching, you have to find what works for you." At least three interpretations seem plausible. First, the finding may suggest a strong individualistic stance toward teaching, something that has been linked to the culture of teaching and of the larger society. Second, this may signal some appreciation for the context-specific nature of teaching practice. In a real sense, teachers are always adapting their practices to the particular students and settings in which they work. Finally, it may suggest that teachers do not feel obligated to justify their practice.

These findings raise questions about how teachers develop their views of learning to teach and whether their beliefs are altered by teacher education or teaching experience. To pursue this question, we need to look for the presence or absence of changes in teachers' beliefs and then link those changes with possible interventions. Still the strong endorsement of firsthand experience as the major source of knowledge and mode of learning underscores the need to create conditions that enable teachers to derive appropriate lessons from their experience.

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Attachment 1

NCRTE Research Reports: Sites, Program Data, and Learner Data

Paper #	Title	Sites	Program Data			Learner Data		
			Observation	Interview	Questionnaire	Observation	Interview	Questionnaire
RR 88-1	Understanding the character and quality of the academic and professional components of teacher education.	Florida ISU MSU						
RR 88-2	Research on teaching mathematics: Making subject matter knowledge part of the equation.	MSU						
RR 88-3	The subject matter preparation of prospective mathematics teachers: Challenging the myths.	MSU						
RR 88-4	Changing mathematical conceptions of preservice teachers: A content and pedagogical intervention.	MSU						
RR 89-1	Changing beginning teachers' conceptions: A description of an introductory teacher education course.	MSU						
RR 89-3	Inservice teacher education in mathematics: Examining the interaction of context and content.	*Detroit Holyoke						
RR 89-4	The teacher, the author, and the text: Variations in the form and content of writing conferences.	Teachers College						
RR 89-5	Thinking about teaching subtraction with regrouping: A comparison of beginning and experienced teachers' responses to textbooks.	Albuquerque Holyoke						
RR 89-6	What are they trying to do? Perspectives on teacher educators' purposes.	Dartmouth Florida MSU Norfolk						
RR 89-7	Learning to teach writing: Untangling the tensions between theory and practice.	Florida ISU						

*Based on off-site data.

Attachment 1

NCRTE Research Reports: Sites, Program Data, and Learner Data								
Paper #	Title	Sites	Program Data			Learner Data		
			Observation	Interview	Questionnaire	Observation	Interview	Questionnaire
RR 89-8	Tilting at webs of belief: Field experiences as a means for breaking with experience.	MSU						
RR 89-9	Orientations toward diversity: What do prospective teachers bring?	Dartmouth Florida ISU MSU Norfolk						
RR 90-1	Learning about mathematics in elementary methods courses.	Dartmouth Florida MSU Norfolk						
RR 90-2	Generic and curriculum-specific instructional planning in alternative routes to certification.	LAUSD NJ						
RR 90-3	Making subject matter part of the conversation or helping beginning teachers learn to teach.	Albuquerque LAUSD						
RR 90-4	Teachers' and teacher candidates' beliefs about subject matter knowledge and about teaching responsibilities.	Dartmouth Florida ISU MSU Norfolk Trenton						
RR 90-5	Talk about text: Changes in content and authority structures in peer response groups.	Teachers College						

Attachment 1

NCRTE Research Reports: Sites, Program Data, and Learner Data

Paper #	Title	Sites	Program Data			Learner Data		
			Observation	Interview	Questionnaire	Observation	Interview	Questionnaire
RR 90-6	Prospective teachers' views of diverse learners: A study of the participants in the ABCD Project.	*Michigan Dept. of Education Dartmouth Florida ISU MSU Norfolk						
RR 90-7	Knowing the subject and learning to teach it: Examining assumptions about becoming a mathematics teacher.	Dartmouth ISU LAUSD MSU						
RR 90-8	The construction of new forms of teaching: Subject matter knowledge in inservice teacher education.	Holyoke Teachers College						
RR 90-9	Beginning teachers and computer networks: A new form of induction support.	*Harvard University						
RR 90-11	What to do about differences? A study of multicultural education for teacher trainees in the Los Angeles Unified School District.	Dartmouth Florida ISU LAUSD MSU Norfolk 5 Michigan Universities						
RR 90-12	Start with the stone, not with the hole: Matching novices' needs with appropriate programs of induction.	Florida Gustavas Adolphus						

* Based on off-site data.

Attachment 1

NCRTE Research Reports: Sites, Program Data, and Learner Data								
Paper #	Title	Sites	Program Data			Learner Data		
			Observation	Interview	Questionnaire	Observation	Interview	Questionnaire
RR 90-13	Adolescent dancing and the mentoring of beginning teachers.	LAUSD						
RR 90-14	Effects of state-level reform of elementary school mathematics curriculum on classroom practice.	*California Reform						
RR 91-1	The role of a learning community in changing preservice teachers' knowledge and beliefs about mathematics education.	MSU						

* Based on off-site data