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MATHEMATICS CLASSROOM INQUIRY:
THE NEED, A METHOD, AND THE PROMISE

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Abstract

This paper, based on the inquiries of the General Mathematics project, makes a case for naturalistic research in mathematics classrooms. In explicating the case, consideration is given to the need for information on classroom practices and the consequence of those practices on teaching and learning. Also considered is the need for research that addresses the problems of practice from the practitioner's perspective. Included is a discussion of the General Mathematics Project's evolution and tentative results. Some of those results are that teachers do teach general-math students differently from algebra students and that most teachers have unusual difficulty teaching general math and often feel only marginally or not at all successful.
MATHEMATICS CLASSROOM INQUIRY: THE NEED, A METHOD, AND THE PROMISE

Perry E. Lanier

Since 1978 my colleagues and I have engaged in participant observation studies in 12 junior high school mathematics classrooms. The classrooms of primary interest have been ninth-grade general-mathematics classes, but for comparative/contrastive purposes we have also looked in algebra classes, remedial classes, a combined seventh-, eighth-, and ninth-grade class, four eighth-grade classes taught by the same teacher, and a ninth-grade social-studies class that included a number of students from an observed general-mathematics class.

Our looking has been driven by the consensus among secondary mathematics teachers and mathematics chairpersons, or supervisors, that ninth-grade general-mathematics classes are unrewarding experiences for both teachers and students. Furthermore, the consequences of being in a general-mathematics class significantly affect students' curricular decisions throughout high school, but, more importantly, constrain their opportunities upon graduation. That is, if they elect to enter college, their range of choice among majors is severely limited given their weak mathematics preparation. Similarly, if they elect to enter the job

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1This paper was presented at an invitational conference sponsored by the Center for Educational Research and Evaluation titled, "Research in Science Education: New Questions, New Directions," Boulder, Colorado, 1980. The research on which this paper is based is supported in part by the National Science Foundation.

2Perry E. Lanier is the coordinator of the IRT's General Mathematics Project and an MSU professor in the Department of Teacher Education.

3The other members of the General Mathematics Project are as follows: Richard Prawat, Bruce Mitchell, James Buschman, Jere Confrey, Sr. Chrisanne Weisbeck, Lucy Knapp, Arlene Anang, Pamela Coe, and Anne Madsen-Nason.
market, their weak mathematical abilities eliminate them from competition for the more desirable positions. Our research objectives have been to accurately and narratively portray life in general—mathematics classrooms with an eye toward improvement, but to date the focus has been on capturing "what is" in contrast to "what can be."

In ascertaining what life for teachers and students is like in these classrooms, we have used field research methodology. Basically, this is an adaptation and extension of ethnography—the method of the anthropologist—for purposes of studying educational settings. Field notes from classroom observations have been the primary data source, but these have been augmented by teacher interview data, student artifacts such as tests, and limited use of videotaping. The participant observers (data gatherers) have been educational anthropologists and teachers or mathematics educators trained to conduct field research. As participant observers we have attempted to not intervene at all in the flow of instructional activity. We have departed from this stance only when it was expedient to interact with a student or students who had asked for assistance or otherwise initiated a dialogue with us. Our task was to be as unobtrusive as possible; we made every effort to study the classroom in its naturalness and wholeness.

The Need for Practical Investigation in Mathematics Classrooms

In 1970 Schwab stated, "My own incomplete investigations convince me that we have not the faintest reliable knowledge of...what actually goes on in science classrooms."

Several years ago the National Advisory Committee on Mathematics Education (NACOME) Conference Board of the Mathematical Sciences reported,
The question, "What goes on in the ordinary classroom in the United States?" is surely an important one, but attempting to survey the status of mathematical education at "benchmark 1975," one is immediately confronted by the fact that a major gap in existing data occurs here. Appallingly little is known about teaching in any large fraction of U.S. classrooms. (NACOME, Note 1)

In 1980 a review of the 580 entries appearing in the tenth annual listing of research on mathematics education, published in the Journal for Research in Mathematics Education, showed that 25 studies, slightly more than 4%, were conducted to address questions of classroom practice (Suydam & Weaver, 1980).

In one sense this last piece of information is encouraging—that there are nearly 600 persons studying some aspect of mathematics education in a given year is commendable. Yet one wonders about the apparent imbalance between the practical and the theoretic when the need for practical/action research has been noted by scholars, teachers, and study groups for at least five or 10 years. Only 25 of the 580 studies (reported in 1979) were directed toward investigating the quality and nature of life in mathematics classrooms, and the remainder are primarily theoretic.

Clearly, the mathematics education research community, as evidenced by its actions and writings, is not unanimously convinced that the classroom is a promising arena for investigation. I contend that the field of science education, as represented by mathematics education, is in need of classroom research. Further, I hope to show, through relating my experiences in the study of general-mathematics classrooms, how such research can uniquely lead to the improvement of science teaching and science-teacher education as well as advancing the science-education research field.
Why Classroom Research is Needed

The intent here is to portray a need for balance between research of the theoretic and research of the practical in the field of science education. Begle and Gibb (Note 2) cast the idea this way in a discussion of "new directions" for research in mathematics education,

Research has developed competing explanations for partial views of learning...but generalizations from these partial theories are limited... they are insufficient for the planning and realization of classroom practices. It is necessary to consider not only the student or the curriculum but also the general context of learning and the teacher's role in effecting learning. (p. 15)

Robert Davis (Note 3) attributed the following to David Hawkins:

"One of the most important--and most neglected--aspects of science (is)
the analysis and explication of practitioner knowledge." Davis continues,

Practitioners do know something, and a major stage in science occurs when theorists study practitioner knowledge and try to relate it to theoretical modes of thought. This stage has been by-passed by education. Teaching is studied with the implicit assumption that teachers do not know what they are doing and theorists must come in and tell them. (Davis, 1977, p. 31)

The argument Davis makes for the need in completing the cycle of educational research activity rests primarily on the notion that without knowing what the practitioner knows, researchers have only a partial picture. However, there is also an implicit point that seems to me to be of equal or greater significance: the notion of the practitioner as a user of research. That is, being in possession of knowledge about practice may indeed make science more complete, but for what purpose?

Is not one of the goals of research to inform and improve practice? Are teachers not influenced by other teachers more than by any other variable? Does it not seem reasonable that research on classroom practices might appear more relevant, and thereby more likely to be perused and used by teachers, than the results of theoretic research?
Tom (1980), in an argument for a conception that portrays teaching as a moral craft rather than an applied science suggests both a need for and a use of research knowledge from the classroom. He observes:

Despite the obvious differences in pedagogical knowledge and skill between the experienced teacher and the typical novice, the craftsman teacher rarely attempts to pass systematically this accumulated wisdom to the next generation...teacher training programs contain little such codified knowledge and skills, and many professors...deny that such craft culture is valuable. Even experienced teachers often deny that their skills and knowledge...could be of value to other teachers.... In other words, all teachers must discover, "what works for them individually"--of matching strategies and ideas to one's personality and to one's unique classroom of youngsters. The result of not receiving craft culture in preservice training--except perhaps in student teaching--and of believing that all teachers must develop a personal teaching style is the conception of teaching as an individualistic enterprise that must be learned by trial and error. (p. 320)

Certainly, anyone who has either taught or closely observed others teaching or learning to teach is familiar with the preponderance of learning by trial and error. If one outcome of classroom research were the reduction of an overdependence on trial and error, it seems certain that practice would be improved. Further, it is conceivable that perusal and use of practical research would begin the extinction of the anti-research attitude common among teachers and would subsequently generate an appreciation of theoretic research as well. Such a state is as desirable for teachers as for researchers because it is the theoretic that provides new ideas that practitioners can adapt to practice.

Given the case for classroom research, what do researchers want to find out? What do they want to become smarter about? Why do they want to become smarter about it? Schwab (1978) contends,

What is wanted is a totally new and extensive pattern of empirical study of classroom action and reaction; a study, not as basis for theoretical concerns about the nature of teaching or learning process, but as a basis for beginning to know what we are doing, what we are not doing, and to what effect; what changes are needed, which needed changes
can be instituted with what costs or economics, and how they can be effected with minimum tearing of the remaining fabric of educational effort. (p. 313)

Clearly Schwab is asking that researchers establish "what is" as objectively as possible, then follow that assessment with evaluative judgments of "what should and could be." On the point of "minimum tearing of the remaining fabric of educational effort," could he have been saying that had these things been considered, the curriculum reform movements of the post-sputnik era would have been implemented differently with different consequences? For example, had educators thought in terms of a soft revolution versus a revolution in school mathematics, what would they have needed to know? What would they have done differently? This information of conditions and their implications for change can only be validly obtained from serious and systematic investigation of classrooms. Furthermore, the implementation of any innovation is perilously endangered without such information.

In summary the need for classroom research appears to be two-fold. First, a knowledge picture of teaching is incomplete without classroom consideration. Second, the knowledge derived and communicated from classroom research is likely to have explicit and useful things to say to the practitioner (a phenomenon which may subsequently endear the teacher to research). Inherent in the two-fold need for practical knowledge and its use are the questions that should be addressed in the context of the classroom. What's happening in the prelude to, during the flow of, and following instruction? What are the teacher's thoughts and actions relative to the classroom experience? What are the learner's thoughts and actions relative to the experience? How is the content of instruction
enacted?

Mathematics Classrooms
Are They All Equally Worthy of Investigation?

Given the need for research in mathematics classrooms, one is confronted with the question of classroom selection, research-site selection. Intuitively, it seems obvious that every potential research site is not as good as every other potential site, but that intuition generates the question of selection criteria. To address this question I will relate the evolution of the General Mathematics Project. The selection of a research site is a complex matter requiring serious thought.

Guidelines for Selecting Classroom Research Sites

Shulman (Note 4), in an invited address to the American Educational Research Association special interest group for Research in Mathematics Education, argued that the "strategic research site" as a concept was a useful guide to educational researchers. His argument attempted to discern those features or qualities that appear to distinguish strategic research sites from other potential loci for empirical investigation. He proposed that striking discontinuity, aberration, anomaly, or error can serve as a strategic research site for studies of human functioning in general and mathematics education in particular.

Mathematics teachers and supervisors express a discontinuity of relative satisfaction regarding their lowest algebra class versus their general mathematics class. Though they are not always satisfied and happy with their algebra classes, there is a noticeable positive-to-negative shift when considering general mathematics. Bruce Mitchell, a mathematics teacher educator and teacher of geometry and general mathematics, stated, "I just can't be me in the general mathematics class"—a discontinuity in terms of his normal and expected style of teaching.
Similarly, he noted a discontinuity in student demeanor and attitudes, "Last year you'd walk down the hall and hear kids say in a positive manner, 'I'm in Mitchell's geometry.' You sure don't hear anyone saying anything about being in Mitchell's general-math class."

A further consideration in selecting a classroom research site is that of complexity. The site should be rich enough to warrant being looked at from several perspectives rather than being a relatively barren single-issue phenomenon. The general-mathematics class, for instance, represents multiple problems: learner problems (computation, reasoning, or reading deficiencies), curricular problems (scope of content), context problems (no one likes to be there, and this has consequences), and teacher problems (how to motivate students, what to expect).

**General Mathematics, A Strategic Research Site**

My decision to focus on ninth-grade general mathematics as a research site emerged from three distinct but nonsimultaneous events. The first of these was the release, distribution, and subsequent deliberations of the 1975 NACOME report (NACOME, Note 1). Though the report contained six chapters, two of them, "Patterns of Instruction" and "Teacher Education" were, for mathematics educators, especially dissonance-producing. It was in the "Patterns of Instruction" chapter that the jarring observation was made that appallingly little is known about what goes on in mathematics classrooms across the nation. The impact of the observation was intensified by reflecting on the level of effort exerted during the sixties on curriculum development and teacher development (though limited primarily to secondary education) and the level of effort (almost nil) exerted on ascertaining what happens to students in classrooms with these curricular materials and teachers. Having some achievement data on students in these classrooms provided little solace for there was
such an obvious gap in the knowledge base.

The significance of the gap was made more disquieting by the reports of teachers in the "Teacher Education" chapter that their most significant problems were those of dealing with motivation, laboratory learning, slow learners, learning styles of students, and the like. "Lowest on the list are content topics" (p. 92). For many in mathematics education, these problems were ones they could finesse by suggesting or implying that they could be dealt with by focusing on interesting and neat mathematical content. However, any distillation or interpretation of what was known and unknown suggested the need for classroom inquiry. But which classrooms? And by what means? In retrospect, the NACOME report was a most influential precursory event in the evolution of the General Mathematics Project.

The second influencing event was the creation, in 1976, by the National Institute of Education (NIE) of the Institute for Research on Teaching (IRT) at Michigan State University's College of Education. Retrospectively, this event had as much influence on how to look as it did on where to look. The IRT focus was to be on the study of teacher thought, but teacher thought in terms of learner, curriculum, and setting. Reading was the curricular area specified, with the option of considering other subject matter areas. In 1977 the IRT sponsored an invitational conference to consider research on teaching mathematics (Institute for Research on Teaching, Note 5).

In addition to the mathematics conference, the Institute also held a conference on field research methodology (Cusick, Note 6). Subsequently, the Institute recruited a field researcher and the MSU College of Education began offering a field-research seminar sequence designed to train personnel to conduct research in educational settings. As a
result of the two conferences, I was prompted to take the field-research seminars. A practicum component in this training led me to observe in a general-mathematics classroom taught by my colleague in mathematics education, Bruce Mitchell.

Mitchell's presence in the general mathematics classroom is the third key event in the evolution of the General Mathematics Project. In a revision of the undergraduate secondary mathematics-methods class, Bruce had negotiated with a local school district to teach a geometry class on a daily, year-long basis. He wanted his methods students to have a weekly field experience in his geometry classroom. During the year in which he taught (1976-77), he discovered that the regular teachers, in their informal exchanges in the hall and lounge, frequently expressed concerns about their general-mathematics classes. For two reasons, his own enlightenment and that of his methods students, he arranged to teach a ninth-grade general-mathematics class in the same high school during 1977-78. This was the site selected for satisfying the practicum requirement of my field research training.

During the course of the year, two inquiries, prompted by my observations in Mitchell's class, furthered the emergence of the General Mathematics Project. The first of these was a question of clarification directed to mathematics supervisor Charles Zoet, who, in a presentation at the annual University of Michigan mathematics education conference, asserted that he and his Livonia (Michigan) secondary teachers were not reaching half their students. His response revealed that these students were similar in many ways to those in Bruce's general-mathematics class. Following this, I made an informal telephone poll of several mathematics supervisors across Michigan and found that at least half the students did take general mathematics. Furthermore, it was not
only a class that generated disquietness and concern among the teachers, but it was equally disquieting to and disliked by the students.

Hence general mathematics was clearly problematic for students, teachers, and supervisors. It was a problem that could only be significantly addressed by study of the problem where it existed—in the thought, actions, and consequences of and for the teachers and students in the general-mathematics classroom. It was indeed a setting worthy of study, a strategic research site.

**Participant Observation**

**A Method For Classroom Inquiry**

The primary observation method used in the General Mathematics Project has been that of participant observation. Since it is virtually impossible for an adult to come across as an adolescent student in any naturalistic sense, as participant observers we have had to establish ourselves as a natural part of the scene in the role of observer.

Since the general-mathematics classroom is, by reputation and consensus, exceedingly complex, the phenomenological approach to participant observation seemed most appropriate for our proposed study. As Carini (1975) states, "The function of observing in phenomenological inquiry is to constitute the multiple meanings of the phenomenon." The task is therefore not to determine the single meaning of an event, but to reveal the multiplicity of meanings. Thus, we chose the phenomenological approach because it was likely that many explanations of the general-mathematics phenomenon are plausible.

Given these theoretical underpinnings of participant observation study, what are the domains where this method is most applicable?

Diesing (1971) responds to this question in this summary paragraph describing the method.
The participant-observer method was first developed by anthropologists, though it is also frequently used by sociologists, social psychologists, political scientists, and organization theorists. Its primary subject matter is a single, self-maintaining social system. The system may be a small community with its own culture, or a larger society with its culture, or a small and relatively isolated neighborhood, or a gang, clique, voluntary organization, or family, or a formal organization or institution, or a person (clinical method), or a historical period. In each case the emphasis is on the individuality or uniqueness of the system, its wholeness or boundness, and the ways it maintains its individuality. The primary objective is to describe the individual in its individuality, as system of rules, goals, values, techniques, defense of boundary-maintaining procedures, and decisions procedures. In one important variant, the primary interest is in recurring processes within or around such individual systems. (p. 5)

Diesing's description shows the method extremely well-fitted for attaining the objectives of the General Mathematics Project--identification and characterization of the manner in which the group identity, classroom organization and process, peer culture, and teacher processes interact to influence mathematics learning both cognitively and affectively, and to focus on the contrasting perspectives of teachers and students on the meanings, events, and purposes of these classes.

As a method, participant observation seems particularly well suited to the investigation of mathematics (science) classrooms, if the researcher's overarching questions emanate from a practical problem. As an example, the two sets of questions we were concerned about in a study funded by the National Science Foundation (The Ecology of Failure in Ninth-Grade General Mathematics: An Ethnographic, Experimental and Psychometric Inquiry) were as follows:

1. Who are the students who become the mathematically disadvantaged ninth-grade population? What are their mathematical abilities, attitudes toward mathematics, learning histories, and learning expectations? How do they wind up in general mathematics?
2. What effects do the two primary instructional environments—general mathematics or first-year algebra classes—have on the cognitive and affective mathematical development of early adolescents? How are those settings experienced by both teachers and learners, whose interactions define those learning environments and their consequences?

If these are representative of the questions that typically characterize a practical problem of the classroom, then the form of the answers to such questions becomes a concern. Clearly, the answers will not be in the form of statistical generalizations. Rather, they are more likely to be in the form of retrospective generalizations. According to Stenhouse (1978), retrospective generalizations are organization(s) of experience in retrospect...are attempts to map the range of experience rather than to perceive within that range the operation of laws in the scientific sense.

Though our analysis of the data gathered to answer the above questions is incomplete, the preliminary form of the answers appears to be that of retrospective generalization. The final section of this paper includes examples of these preliminary conclusions.

Findings From Classroom Research:
Of What Use?

The following preliminary findings of our investigation are presented as an example of outcomes of classroom research where the primary method is participant observation. Perusal of these preliminary findings will, I hope, be illuminating in terms of their usefulness to teachers, policy makers, and researchers.

1. Tracking, the policy commonly used for placing students within ninth-grade mathematics—whether into algebra or general mathematics—is usually highly correlated with students' records in mathematics classes during junior high school.

2. Teachers instruct general-mathematics classes differently than they instruct algebra classes. Further, these differences appear to be critical factors since they include aspects of teaching that are recognized as clearly related to student learning.
3. Most secondary mathematics teachers find it easier to think about, to plan for and to teach mathematically advanced classes than to do so for general-math classes. Part of this imbalance stems from their difficulty in comprehending that students in general mathematics can have serious problems in learning basic content.

4. Most teachers assigned to teach classes with a high percentage of youngsters identified as having low promise for successful achievement in mathematics (i.e., general-mathematics classes) have unusual difficulty in teaching these classes and often feel only marginally or not at all successful.

5. The low incidence of success and high incidence of frustration and failure encountered by both teachers and learners in general mathematics classes have created unique instructional settings that are notorious for their unpleasantness.

6. Though educators know that most general-mathematics students have a diversity of learning problems at a critical level, they do not know the precise nature of these problems.

7. Well established is the troublesome and problematic nature of teaching and learning general mathematics at the ninth-grade level. Not well established are practices that alleviate the problem.

8. Overall, students placed in general mathematics classes appear to be different, in certain important ways, from students placed in algebra classes.

Given these preliminary findings let me conclude by returning to the quote of Schwab that I used in my argument for the need of classroom research:

> What is wanted is a totally new and extensive pattern of empirical study of classroom action and reaction; a study not as basis for theoretical concerns about the nature of teaching or learning process, but as basis for beginning to know what we are doing, what we are not doing, and to what effect; what changes are needed, which needed changes can be instituted with what costs or economics and how they can be effected with minimum tearing of the remaining fabric of educational effort. (p. 313)

I suggest that our findings are informing researchers and educators about what teachers are and are not doing in general-mathematics classrooms and to what effect. Teachers reading these findings may become aware of some changes they could and should make. In short, I believe our
findings hold promise for improving the practice of teaching mathematics in particular and teaching in general.

In school mathematics there are numerous phenomena that mathematics educators are ethically and professionally responsible for becoming smarter about. For many of these there is no more appropriate method than observing in the natural setting of the classroom. I urge mathematics educators to be responsive to this need in the field of mathematics education.
Reference Notes


References


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The IRT conducts major research projects aimed at improving classroom teaching, including studies of classroom management strategies, student socialization, the diagnosis and remediation of reading difficulties, and teacher education. IRT researchers are also examining the teaching of specific school subjects such as reading, writing, general mathematics, and science, and are seeking to understand how factors outside the classroom affect teacher decision making.

Researchers from such diverse disciplines as educational psychology, anthropology, sociology, and philosophy cooperate in conducting IRT research. They join forces with public school teachers, who work at the IRT as half-time collaborators in research, helping to design and plan studies, collect data, analyze and interpret results, and disseminate findings.

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ASKING THE RIGHT QUESTIONS
ABOUT TEACHER PREPARATION:
CONTRIBUTIONS OF RESEARCH ON
TEACHER THINKING

Christopher M. Clark

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Abstract

Research on teacher thinking has established a place for itself within the international educational research enterprise. What is not so clear is how studies of teacher thinking may be of use in improving the quality of teacher preparation programs. This paper promotes a consultant role for researchers on teacher thinking in relation to teacher educators. The current state of knowledge about teacher thinking is summarized under three headings: Implicit Theories and Preconceptions, Planning and Reflection, and Uncertainty and Dilemmas. After each summary, a list of questions offered as food for thought in the pursuit of understanding and improving learning to teach. The author claims that research on teacher thinking improve teacher preparation by encouraging thoughtful teacher educators ask better questions of themselves and of their arts.
ASKING THE RIGHT QUESTIONS ABOUT TEACHER PREPARATION:
CONTRIBUTIONS OF RESEARCH ON TEACHER THINKING

Christopher M. Clark

The field of research on teaching thinking is thriving and growing. But what is not so clear is how (or whether) this research can be informative and useful to teacher educators. What conditions must be satisfied in order to move from the literature on teacher thinking to more thoughtful practice of teacher education? And what first steps have already been taken to realize some of the practical promise of teacher thinking research? This paper addresses these questions within the larger framework of the relationship between research and practice in education.

There are three ways to characterize the relationship between research on teaching, on the one hand, and teacher education, on the other hand. In the worst case, research on teaching has no relationship at all to the practice of teacher education. Researchers pursue their own narrow and parochial interests, publish in obscure language in obscure journals, and avoid all discussion of practical implications of their work. For their part, teacher educators see this kind of research as irrelevant and impossible to understand, and continue to use unexamined habits and traditional ways of preparing teachers.

A second and better kind of relationship between research on teaching and teacher education follows from research in the process-product

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1 This paper was presented at the third Conference on Teacher Thinking and Professional Action sponsored by the International Study Association on Teacher Thinking at Leuven University, Belgium, on October 16, 1986.
2 Christopher Clark is coordinator of the Written Literacy Forum and professor of educational psychology at Michigan State University.
tradition. Teacher effectiveness researchers see their role as discovering those behaviors, skills, patterns, and strategies that lead to improved student learning and achievement. In this framework, the implications for teacher education are rather direct: Train prospective teachers to behave in the ways that research has shown to be most effective in producing achievement gains in students. The principal role of the teacher educator in this relationship is that of trainer of students in the skills and strategies documented by the research community. This is an essentially top-down model in which researchers and the knowledge they produce govern the content and practice of teacher preparation.

In this second kind of relationship between research and practice there are teacher educators who have read one or two reviews of the literature of teacher thinking, who have attended conference presentations of this research, or who have colleagues who are engaged in studies of teacher thinking. These teacher educators may have a felt sense that there is some potential in this work for affecting their conduct of teacher preparation, but may not know quite what to do about it. Some are awaiting a hypothetical "Phase 2" of research on teacher thinking, when researchers move from description of the ways teachers think to quasi-experiments and other tough-minded designs from which prescriptions will flow for how teachers ought to think, plan, and decide. In my opinion these teacher educators wait in vain. Research on teacher thinking will never provide a scientific basis for prescribing how teachers ought to think.

I want to propose a third kind of relationship between research on teaching (particularly research on teacher thinking) and the practice of teacher education. In this relationship members of the research community behave as consultants to the community of teacher educators. To work well
as a consultant one must come to see the client's (teacher educator's) problems from the perspective of a sympathetic outsider. A good consultant has expertise and a perspective different from that of the client and engages this expertise in the service of the client's own short and long term ends. A consultant seldom solves major problems but often contributes important pieces to the client's own solutions. The best consultants are those who leave us with something interesting and provocative to think about as we continue to wrestle with the complexities of our own local problematic situation. What I am calling for here is a more humble and service-oriented role for research on teaching in relation to teacher education—a relationship in which researchers provide food for thought responsive to the perceived needs of teacher educators. It is in this kind of a relationship that I see great promise for research on teacher thinking as a source of valuable assistance in the thoughtful preparation of teachers.

In this third kind of relationship we have teacher educators who have learned a bit about research on teacher thinking, who have the felt sense that something ought to be done with this work, and who have begun to think about their teaching of novices in light of new descriptions of the way teaching is. These teacher educators are not waiting for researchers to tell them what to do next. Some have begun applied research programs of their own. Others have begun to make small changes in the content of their teaching and in the ways that they teach. Still others have begun the demanding and politically complicated process of reorganizing whole teacher preparation programs to reflect their collective and emergent sense of what constitutes progress in teacher education. These are the leaders and risk takers in teacher education to whom research on teacher thinking can be most useful.
Four General Claims

Given this way of thinking about the relationship of research and practice, I have four general claims to make about the promise of research on teacher thinking for influencing teacher education:

1. Research on teacher thinking has small but important contributions to make to the practice of teacher education. I do not see in research on teacher thinking the grounds for radical revision of the form and content of teacher preparation. Some of the most important contributions to teacher education may take the form of rationalizing, justifying, and understanding practices which have long been in place in teacher education. Furthermore, many contributions of research on teacher thinking will not make teacher education easier, but they may make teacher preparation more interesting.

2. The study of the thoughts, knowledge, and dispositions of experienced teachers (important as this is) does not answer the questions of what novices should be taught and how they should be prepared. There are two interrelated problems here: (a) Most of this research describes teacher thinking, planning, and decision making without taking an empirically supported position on the effectiveness or desirability of these forms and patterns of teacher thinking; and, (b) even if these forms of teacher thinking are shown to be desirable for teachers, it remains to be discovered how one might best help start inexperienced prospective teachers moving in these directions.

3. Particular changes and improvements made in the content and process of teacher preparation ought to be invented, tested, and adapted by teacher educators themselves. Research on teacher thinking can provide examples of concepts, methods, and food for thought for teacher educators but not well-defined prescriptions for how to educate teachers. (The ideal situation,
from my point of view, is when researchers on teacher thinking themselves become practicing teacher educators and learn how to apply their research to their own teaching.)

4. Fourth, and finally, I believe that research on teacher thinking has already begun to affect the ways we think and act as we prepare novices for the teaching profession. Teacher educators are asking thoughtful questions about the content and process of their work, and, in the last five years, a number of interesting and encouraging program innovations have been started with still more in the planning stages. To date, research on teacher thinking has perhaps affected the ways in which teachers are prepared more visibly than it has affected the ways teachers teach in classrooms.

Thinking From the Research

Suppose that a researcher on teacher thinking is invited to consult with a faculty of teacher educators. What could he or she offer as food for thought to these teacher educators as they think about strengthening their own teacher preparation program? I want to describe a handful of ideas from research on teacher thinking that such a consultant could offer in response to the teacher educators' needs. I group these ideas under three headings: Implicit Theories and Preconceptions, Planning and Reflection, and Uncertainty and Dilemmas.

Implicit Theories and Preconceptions

Research on teacher thinking has documented the fact that teachers develop and hold implicit theories about their students (Bussis, Chittenden, & Amarel, 1976), about the subject matter that they teach (Ball, 1986; Duffy, 1977; Elbaz, 1981; Kuhs, 1980) and about their roles and responsibilities and how they should act (Ignatovich, Cusick, & Ray, 1979; Olson, 1981). These implicit theories are not neat and complete reproductions of
the educational psychology found in textbooks or lecture notes. Rather, teachers' implicit theories tend to be eclectic aggregations of cause-effect propositions from many sources, rules of thumb, generalizations drawn from personal experience, beliefs, values, biases, and prejudices. Teachers are subject to the full range of insights and errors in human judgment (described by Nisbett & Ross, 1980), just as all humans are when faced with complex, fast-paced, consequential, and occasionally emotion-laden social judgments and action situations. And teachers' implicit theories about themselves and their work are thought to play an important part in the judgments and interpretations that teachers make every day.

As the term "implicit theory" implies, these systems of thought are not clearly articulated or codified by their owners but are typically inferred and reconstructed by researchers on teacher thinking. The study of implicit theories employs various methods including stimulated recall interviews, linguistic analysis of teacher talk, paragraph completion tests, responses to simulation materials such as vignettes describing hypothetical students or classroom situations, and concept generation and mapping exercises such as the Kelly Repertory Grid Technique. Research designs also vary considerably from ethnographic case studies of one or two teachers (Clandinin, 1986; Elbaz, 1981; Kroma, 1983) to standardized administration of a belief inventory, judgment task, or stimulated recall protocol to several teachers (e.g., Conners, 1978; Marland, 1977; Munby, 1983). Variability in researchers' methods, designs, contexts, and interpretive frames of reference leads to great variability in how teachers' implicit theories are described.

Leaving teachers and their implicit theories for a moment, let me turn to research that is primarily about students learning science. Studies of the teaching and learning of science (e.g., Roth, 1985; Roth, Smith, &
Anderson, 1983) indicate that students come to a science lesson or course with preconceptions about the phenomena and processes in the science curriculum. For example, fifth graders come to a lesson on photosynthesis with their own ideas about how plants get nourishment or to a physics unit on light and vision with preconceptions about how we see. Often, these preconceptions are incomplete, flawed, and in conflict with currently accepted scientific explanations. And almost always, students' preconceptions are robust, that is, students continue to hold and think from flawed but familiar preconceptions about the world even after having been taught scientifically correct explanations (Roth, 1985). Researchers advocating an approach to teaching called "teaching for conceptual change" (Posner, Strike, Hewson, & Gertzog, 1982; Roth, 1985) have demonstrated that students' preconceptions can be revised or replaced with scientifically correct conceptions only if considerable teaching time and energy are devoted to unmasking and incontrovertibly confronting students' misconceptions before proceeding with instruction.

So, back in our consultant role, what do we have to work with, in the service of teacher educators? Teachers have implicit theories, students have preconceptions. Both are robust, idiosyncratic, sensitive to the particular experiences of the holder, incomplete, familiar, and sufficiently pragmatic to have gotten the teacher or student to where they are today. Neither are likely to read like a textbook or to be quickly and thoroughly replaced by the usual lecture, reading, discussion, practice, and evaluation methods typically employed in teacher preparation programs. Implicit theories and preconceptions affect perception, interpretation, and judgment and therefore have potentially important consequences in what teachers and students do and say.
In the context of teacher education I believe these claims and information about implicit theories and preconceptions have some interesting and provocative implications. Students begin teacher education programs with their own ideas and beliefs about what it takes to be a successful teacher. These preconceptions are formed from thousands of hours of observation of teachers, good and bad, over the previous fifteen or so years. Undoubtedly, students' conceptions of teaching are incomplete, for they typically see and hear only the performance side of classroom teaching. With this in mind, a thoughtful teacher educator might ask: What are the preconceptions about teaching and learning held by our students? How should we take account of what our students know and believe as we help them prepare to be teachers? How might we structure field observations early in a teacher preparation program to make visible important aspects of teaching not usually obvious to primary school or high school students? What do prospective teachers believe about the integration of subject matter knowledge with pedagogical skills, and what does our preparation program offer to support or challenge and replace these preconceptions? Notice that these are not questions to which research on teacher thinking offers answers. But rather these are potentially useful questions that might not otherwise have been asked in the absence of research on teacher thinking.

Beyond pursuing answers to questions about prospective teachers, this research can stimulate introspective questions about teacher educators themselves. What do we as teacher educators believe about teaching and learning, individually and as a faculty? How consistent are our espoused beliefs with our methods of teaching and evaluation? (that is, do we practice what we preach?) Are the implicit and explicit theories of teacher educators who supervise practice teaching likely to dominate and wash out what has been
taught earlier in a teacher preparation program? How does variability in implicit theories among supervisors of practice teaching influence and bias their judgments and evaluations of our students?

Asking questions like these has led a number of teacher educators to take the risky and exciting step of systematically studying their own practices. For example, a few studies of the influence of implicit theories and belief systems of clinical supervisors on their judgments of student teachers have been completed recently (Niemeyer & Moon, 1986; Rust, 1986). These studies have contributed to deliberation about who should be doing clinical observations (i.e., Should this usually low-status task be delegated to inexperienced graduate assistants, to experienced teachers hired for these purposes, to experienced teacher educators, experts in the academic disciplines, or teams from two or three of these groups?), how clinical observations should be done, what kinds of evidence might be used in student teacher evaluation, and how clinical supervisors might prepare themselves for their important and demanding work. This research has also begun to contribute to an enhanced sense of professional identity among teacher educators who specialize in clinical supervision, insofar as it has demonstrated the complexity and intellectual demands of this aspect of teacher education and drawn attention to the potentially pivotal role of the clinical supervisor in the process of teacher preparation.

Planning and Reflection

Research on teacher planning consists of a score or more of studies every bit as variable in method and design as the work on implicit theories. Two distinctive features, however, set planning apart from implicit theories. First, virtually everyone involved with education agrees that planning is a real phenomenon, that is, all teachers do something they call
planning at some times. And second, many now see teacher planning as the instrumental linking process between curriculum on the one hand and the particulars of instruction on the other.

Psychologically, to understand teacher planning is to understand how teachers transform and interpret knowledge, formulate intentions, and act from that knowledge and those intentions. From the curriculum theorist's point of view, the study of teacher planning can help explain why and how curriculum materials are understood or misunderstood, used, distorted, ignored, or transcended in classroom instruction. Politically and administratively, to control teacher planning is to control, in large measure, the content, pace, emphasis, and process of instruction. And, from the practicing teacher's point of view, the study of teacher planning can enhance appreciation of the genuinely professional (as distinct from technical) aspects of teaching; that is, the study of teacher planning can and has documented the many heretofore unappreciated ways in which the practice of teaching can be as complex and cognitively demanding as the practice of medicine, law, or architecture.

I know that those of us who began to do research on teacher planning 10 or 12 years ago did not anticipate that this work had potential for being so central to the concerns of so many audiences. It has only been in hindsight that I have come to believe that to understand teacher planning is to understand teaching; that the study of how teachers prepare for instruction can reveal a great deal about which features of subject matter, students, and of the physical, psychological, administrative, and political environments actually influence classroom instruction. We can theorize with the best of intentions about how teaching and school learning could be optimized, but our finest ideas and proposals must still pass through the funnel of teacher planning.
After this big buildup, I am a bit embarrassed to admit that research on teacher thinking has made only modest beginnings in the study of teacher planning. We know, for example, that experienced teachers do several different types of planning in the course of the school year (Clark & Yinger, 1979), that the time-honored rational model (moving from learning objectives, through generating alternatives, to choice of an optimal alternative) is not used regularly by experienced teachers (Morine-Dershimer & Vallance, 1976; Yinger, 1977) (Although experienced teachers do claim that the rational model ought to be taught to novices; see Neale, Case, & Pace, 1983). Teachers do attend to learning outcomes, sometimes prior to teaching (while planning), sometimes during teaching, and sometimes only after interactive teaching is over (McLeod, 1981). Teachers also attend to goals, issues, and concerns other than learning outcomes in their planning. And the teacher planning process serves immediate personal purposes for teachers, such as study of content, anxiety reduction, and confidence building, as well as longer range instrumental purposes, determining the content and structure of classroom interaction (Carnahan, 1980; Hill, Yinger, & Robbins, 1981; Peterson, Marx, & Clark, 1978).

Psychological models of the planning process have been proposed and, to some degree, tested against the realities of practice (e.g., Clark & Yinger, 1979; Yinger, 1977). And styles of planning used by experienced teachers such as "incremental planning" and "comprehensive planning" (Clark & Yinger, 1979) have been described. Curriculum planning has been shown to vary with the subject matter under consideration and with the degree of novelty or familiarity of the material, students, and teaching setting (Clark & Elmore, 1981). American elementary teachers report spending relatively large amounts of time planning (10 to 20 hours per week) but also report that
relatively little time or support for planning are officially sanctioned or encouraged (Clark & Yinger, 1979). An important product of the planning process is routines (Yinger, 1979) or structured patterns of teacher and student behavior. The first weeks of the school year have been shown to be a particularly important period for teacher planning, inasmuch as many of the routines, rules, relationships, and expectations that influence classroom interaction during the remainder of the year are planned, negotiated, replanned, and established during that time (Anderson & Evertson, 1978; Buckley & Cooper, 1978; Clark & Elmore, 1979; Shultz & Florio, 1979; Tifunoff & Ward, 1978).

In the process of reviewing the literature of research on teacher thinking several times (e.g., Clark, 1983; Clark & Peterson, 1986; Clark & Yinger, 1977), I have come to both bless and curse a distinction made by Philip Jackson almost two decades ago—the distinction between proactive teacher behavior and interactive teaching (Jackson, 1968). On the side of blessings and gratitude, this distinction serves me well as an analytic tool for defining the boundary between studies of teacher planning (proactive teaching) and studies of teacher interactive thinking and behavior. If no students are physically present, we are dealing with proactive teaching; and if students are present, we are dealing with interactive teaching. The distinction is clear, simple, and has great face validity—the empty classroom is clearly a different place from the classroom populated with teacher and students engaged in the business of teaching and learning.

But, more recently, this distinction has given me pause, and even trouble. For, whereas much of teacher planning begins and ends in the empty classroom, I have come to believe that planning does not stop when students arrive, that teachers can plan and revise plans "on their feet," and that reflection on plans and on classroom experiences can be an important
influence on teacher planning—no matter when that reflection takes place. Teacher thinking is both more messy and more integrated (in the person of the teacher) than Jackson's neat distinction suggests. The iterative and social nature of teaching allows and encourages revision, postponement, elaboration, or abandonment of yesterday's plan in response to today's experience in the classroom. The distinctions between planning and teaching, between preactive and interactive thinking, begin to blur and become fuzzy. There is a danger of forcing the phenomenology of teaching to fit models and categories of researchers, possibly distorting and misunderstanding the essential richness and dynamism of teacher thinking. The study of reflection, post-hoc analysis, and response to apparent failures; of interruptions, negotiations, teaching disasters, and desperate inspirations may contribute as much to understanding planning and teaching as the direct study of preparing for instruction.

One of the side effects of doing research on teacher thinking has been the discovery and elaboration of techniques and procedures for promoting reflection and analysis by teachers of their own thinking and behavior. These techniques include journal keeping, clinical interviewing, stimulated recall procedures in which teachers view videotape recordings (or sometimes listen to audiotapes) of their teaching and respond to questions about their thinking, perceptions, decisions and intentions, and concept-generation and conceptual-mapping tasks. To study teacher thinking researchers must depend on teachers to think aloud, either while in the act of thinking and deciding, or retrospectively; we cannot observe thought directly.

Hand in glove with these technical developments is the development of a commitment to including teachers themselves as full partners in the study of teacher thinking. To some degree, this change in the role that teachers
play in the research process from experimental subject to colleague and collaborator follows from the invisible nature of teacher thinking and from the model role of the "informant" in ethnographic studies of societies linguistically and culturally different from that of the anthropologist. And, in part, the enhanced role of teachers in research on teacher thinking reflects ideological and political commitments to share power more equitably between the communities of research and of practice. In any case, teachers have found themselves thinking aloud, reflecting, raising, and refining questions about their knowledge and practice; writing; analyzing data; making formal presentations of research in which they have been involved; and publishing for audiences of researchers and teachers. A great deal of this has happened in the last eight years, and these developments are due largely to the advent of research on teacher thinking (Porter, 1986).

While working with teachers on research projects in these ways, I noticed a recurring theme in our conversations that concerns the powerful effects on teachers of reflecting on their own practice. Experienced teachers report that describing their plans and intentions, explaining their reasons underlying action and decision, and responding to the questions and presence of an informed, nonjudgmental adult seems to breathe new life and meaning into their teaching. Usually, teaching is an action-oriented, operational, "don't look back, they may be gaining on you" profession. But the intervention of researchers describing planning, thinking, and decision making has required that teachers stop and think, find words and reasons for their thoughts and beliefs, and take a second look at themselves and their teaching.

Although not intended by the researchers as professional development activities, the journal keeping, clinical interviews, stimulated recall sessions, and articulation of beliefs and implicit principles of practice
have instigated a new awareness among a few teachers. These techniques and
the genuine human interest in understanding that accompany their use may
constitute professional development activities of the broadest kind—that
is, they may enable teachers to see and appreciate what is genuinely profes-
sional about their work; to kindle or revive the idealism, freshness, and
commitment to self-improvement that we often see in the best first-year
teachers, but this time, with a difference: the difference that years of
accumulated practical wisdom brings. In sum, reflection by teachers makes a
difference, albeit a difference expressed in many different ways.

Now, what does this mix of fact, theory, and opinion say to our consul-
tant, trying to be helpful to teacher educators? He or she might bring
questions like these to deliberations about teacher preparation: When and
how do prospective teachers learn about and practice planning? How many
kinds of planning do they practice? To what extent does their practice
planning take account of the structural and practical differences between
school subject matters (e.g., the concept of "guided practice" may be real-
ized in quite different ways in the contexts of essay writing or math
problem solving)? Is the theory and practice of planning as expressed in
university courses consistent with the procedures and criteria for success-
ful planning built into the practice teaching experience? What do our
approaches to training teachers to plan reveal about our implicit theories
of teaching (e.g., teaching as literal implementation of curriculum mate-
rials, as imitation of experienced models, as curriculum building and adap-
tation, as behavior management)? If planning during the first days and
weeks of the school year is so important, do our prospective teachers ever
get to see and participate in this kind of planning?
To what extent do our teacher education students have opportunities to plan, teach, replan, and reteach, thus learning about the limits of foresight and about improvement-oriented self-observation? Do we include techniques and opportunities for reflection and professional communication among teachers in our training programs? And how do we, the teacher educators, show that we value and practice reflection and self-examination about our own teaching? Again, our researcher-consultant brings no crisp and prescriptive answers to these questions. But they are questions worth pursuing, and the pursuit must be framed by the all-important context of particular professional preparation programs. Teacher planning and reflection are not the whole of teaching, but research on teacher thinking suggests to me that they deserve explicit and creative attention throughout a sound teacher education program.

Uncertainty and Dilemmas

The third set of contributions of research on teacher thinking to discourse about teacher preparation concerns the very nature of the teaching situation itself—not "what works," but "what it is really like out there," as seen through the eyes of teachers themselves. In three words, teaching as experienced is complex, uncertain, and peppered with dilemmas.

The research on teacher planning alluded to above speaks eloquently to the complexity and uncertainty inherent in interactive teaching. Indeed, a great deal of teachers' planning energy goes into trying to predict and anticipate potential problems, guess and estimate what students already know and how they might respond, and to forming plans and routines that are robust to the interruptions and distractions that assault most teachers most of the time.
Researchers have also studied the thinking and decision making that teachers do during the act of teaching. This research has explored the extent to which teachers make on-the-spot decisions that change their plans or behavior in the classroom, and attempted to identify the cues used by teachers in reaching these interactive decisions. A few studies have explored the relationships between patterns of interactive decision making and student achievement, and some compare thinking processes of experts with those of novices in the same situations. Like the literature on teacher planning, the number of studies available is small and the teachers studied are mostly experienced elementary school teachers.

Research on interactive decision making indicates that teachers encounter decision situations at two-minute intervals while teaching—literally hundreds of decision points per day. This research also indicates that the greatest proportion of teachers' interactive thoughts is about students (between 39% and 50%), followed by instructional behavior and procedures, content, materials, and learning objectives (Peterson & Clark, 1978). Marland (1977) categorized teachers' interactive thoughts as perceptions, interpretations, anticipations, and reflections. There is some evidence to support the idea that teachers consider improvising major changes in instructional process primarily when their teaching is going poorly; that is, when the myriad adjustments and small changes that teachers make in the ongoing classroom process prove insufficient in maintaining the flow of the lesson (Peterson & Clark, 1978). This is consistent with findings from studies of the cognitive processing of professionals in other fields who are described by Simon (1957) as pursuing a strategy of "satisficing" rather than optimizing. Research by Doyle (1979) also indicates that it is "adaptive and efficient for a teacher to direct conscious processing primarily to discrepancies or anomalies. By specializing in discrepancies, a teacher can
anticipate disruptions and reduce the effects of immediacy and unpredictability on task accomplishment" (Doyle, 1979, pp. 62-63).

Leinhardt and Greeno (1984) describe the cognitive structures that teachers use to move back and forth between implementing planned routines and adjusting their actions to new information that becomes available in the course of a lesson. They found experienced teachers to be distinguished by their ability to obtain and retain new information in interaction with students while continuing to maintain control of their agenda. Others have compared the schema that experienced teachers use to understand what is happening in the classroom with the way novices understand the same situation (Calderhead, 1983; Housner & Griffey, 1983).

Three studies examined the relationship between interactive decision making and student on-task behavior or achievement (Doyle, 1977; Morine & Vallance, 1975; Peterson, Marx, & Clark, 1978). The interactive decision making of effective teachers is characterized by rapid judgment, "chunking" of many events and cues into a few categories, differentiation of cues and events as to their importance, and a willingness to change the course of classroom interaction when necessary. The studies of teacher planning and decision making tell us a great deal about the task demands of teaching as well as about how particular teachers cope with those demands. The task environment of the classroom has been characterized by Shulman (1984) as more complex than that faced by a physician in a diagnostic examination. This complexity has been described by Clark and Lampert (1986, p. 28) as follows:

The teacher encounters a host of interrelated and competing decision situations both while planning and during teaching. There are no perfect or optimal solutions to these decisions. A gain for one student or in one subject matter may mean a foregone opportunity for others. A motivationally and intellectually profitable digression may reduce time devoted
to the mandated curriculum. Such conflicts among teachers' multiple commitments lead to practical dilemmas (Berlak & Berlak, 1981; Lampert, 1984) which must be managed in interaction with students. Conflicting goals, combined with endemic uncertainty about how to achieve desired outcomes can lead to "knots" in teachers' thinking (Wagner, 1984). Often these entanglements can only be sorted out as the teacher experiments with action and observes its outcomes (Lampert, 1985). By such experimentation, teachers build a store of personal practical knowledge about how to get their job done (Clandinin & Connelly, 1984).

So, research on teacher thinking has made an empirical case that the practice of teaching is complex, uncertain, and dilemma-riddled. And this research has described how some teachers see, feel, and cope with the grayness. What questions might our hypothetical consultant raise with teacher educators that follow from seeing teaching thus? First, one might ask how thoroughly and persuasively a teacher preparation program informs its postulants that there is more to teaching than meets the eye; that expertise in teaching is less a matter of knowing all the answers than a matter of making the most of the unexpected. Whereas the system of education in China supports the role of the teacher as a virtuoso who creates, practices, and polishes exquisitely set pieces of pedagogical performance (Paine, 1986), the teacher in American schools is faced with a mind-boggling array of mutually incompatible expectations and imperatives.

Do prospective teachers hear this, come to believe this, and take it into account in forming their emergent expectations and implicit theories? Do methods courses, microteaching, and other preparatory experiences reflect the intrinsic uncertainty of teaching? Or do teacher education programs control, oversimplify, and distort practice teaching and field observation experiences to such a degree that our students' practice time is wasted or misdirected in irrelevant and unrepresentative test-like activities? Do the teachers of teachers have the courage to think aloud as they themselves wrestle with troubling dilemmas about depth versus breadth of content
studied, distribution of time and attention among individual students, making inferences about what students know and what grades they should be assigned?

Do we claim to be graduating fully functioning teachers or novices well started? How might teacher preparation programs be sowing the seeds of learned helplessness and incompetence by advocating practices that simply do not work for novices? For example, teacher educators in two otherwise exemplary preparation programs (studied by Ball & Feiman-Nemser, 1986) taught their students that good teachers don't use published textbooks or basal readers, they create their own materials. This well-intentioned advice set up students for failure and embarrassment during practice teaching because the teacher preparation program did not equip these beginners to create original materials of high quality and practicality and because their experienced cooperating teachers typically relied on textbooks and basal readers quite heavily. Here we have a case of unintentional sabotage of a potentially crucial learning experience.

I will say one final time that research on teacher thinking does not promise to discover a generically effective method or set of techniques for dealing with uncertainty, complexity, or dilemmas. By their very natures these qualities defy the quest for a technical fix. But I do claim that the teacher educator who tells it like it is, who abandons the fiction that teaching can become a technically exact scientific enterprise, and who has the courage to reveal how he or she agonizes over real dilemmas and contradictions--that teacher educator is likely to be successful at helping prospective teachers to prepare themselves for uncertainty. That teacher educator is likely to minimize the boredom and burnout that plague our profession. That teacher educator is asking the right questions about teacher preparation.
Conclusion

Teacher preparation is already being affected, to some degree, by research on teacher thinking. Thoughtful teacher educators are learning about this research, thinking from it, and asking questions about the ways in which they help their students become well-started and thoughtful novice teachers. Research on teacher thinking has helped us to appreciate in some detail the complexity, artistry, and demandingness of classroom teaching. And this work now serves as rich food for thought (and action) for colleagues who have chosen the challenging work of influencing the knowledge, skills, and dispositions of those who would teach. I hope that this great conversation broadens and continues, with researchers, teacher educators, and those who play both roles pursuing answers to the big question: How can we help our students to prepare themselves to think and act in ways that will eventually become good teaching?
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