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ABSTRACT

The objective of an early field experience program is to force students to confront their assumptions on teaching. The experience, coupled with activities and readings in the university classroom, is designed to make students reconsider a variety of issues--what it means to learn something, the intellectual capabilities of children, the role of the teacher, and students' own knowledge. To achieve these ends, students wrestle with a seemingly simple piece of mathematics; they then see a class of third graders discussing the same mathematics. The students interview the teacher of the class about her purposes, her knowledge of both mathematics and learners, and her approach to teaching. They then interview a third grader, discussing their own understanding of mathematics and their feelings about the class. Finally, they attempt to teach the mathematics to someone. Excerpts are included from students' papers and from their final examination in which they had to compare two teachers' approaches to teaching operations with negative numbers. (Author/JD)

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Research Report 89-8

Tilting at Webs of Belief: Field Experiences as a Means of Breaking With Experience

G. Williamson McDiarmid

National Center for Research on Teacher Education

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Abstract

Early field experiences are typically intended to show beginning teacher education students what "teaching is really like." The author of this paper describes an early field experience intended to force students to confront their assumptions. Early field experiences are usually an initial submersion in a lengthy socialization rite that culminates in student teaching. The experience, coupled with activities and readings in the university classroom, is designed to force students to reconsider a variety of issues: what it means to learn something, the intellectual capabilities of children, the role of the teacher, and students' own knowledge. To achieve these ends, students wrestle with a seemingly simple piece of mathematics. They then see a class of third graders discussing the same mathematics. They interview the teacher of the class about her purposes, her knowledge of mathematics and learners, and her approach to teaching. They then interview a third grader, discussing both their understanding of mathematics and their feelings about the class. Finally, they attempt to teach the mathematics to someone.

To document his students' learning, the author offers quotations from students' papers and their final examination in which they had to compare two teachers approach to teaching operations with negative numbers. While many students appear to reconsider their fundamental understandings of themselves as learners, their knowledge of subject matter, the capabilities of children, and the role of the teacher in the learning process, the author warns that his students may have merely figured out what he wants to hear. Further, he has no evidence that even if students' genuinely reconsider their views, such reconsiderations are not reversed by subsequent experience in teacher education.

TILTING AT WEBS OF BELIEF: FIELD EXPERIENCES AS A MEANS OF BREAKING WITH EXPERIENCE[1]

G. Williamson McDiarmid[2]

Viewing Teaching as a Problematic Practice

Twenty-two undergraduate teacher education students are sitting on folding chairs or an old sofa at the back of a typical third grade classroom. They are enrolled in the introductory teacher education course at Michigan State University. The discussion they are currently having with the third-grade mathematics teacher is part of their field experience. In five minutes, the third graders at Spartan Elementary School will return from recess. The teacher, Deborah Ball, has been describing her plans and goals for the upcoming lesson and has passed out to the university students a three-staged "mystery number" worksheet she has devised. The students are present in Ball's classroom because their university instructor (that's me) knows that they will see mathematics and learners treated in ways that will not accord with their prior experience. In addition to teaching third-graders mathematics each day, Ball is a researcher and scholar who has written extensively about what she terms "mathematical pedagogy" (Ball, 1988a).

One of the university students raises his hand and says, "There's a mistake in this which makes it impossible to solve."

Ball and the other students study the sheet again.

"You're right," she says, "What do you think I ought to do about it?"

Ball and the university students discuss the pros and cons of using the assignment as is. The students worry that the third graders will become confused and frustrated or may learn things that are incorrect. Ball listens and points out that this is an example of the kinds of dilemmas teachers frequently face: Should she, at the eleventh hour, scrap the assignment and her plans or give them the assignment, trusting in their capacity to figure out what is wrong with it? As the first third-grader comes through the door, Ball announces, "I'm going to use it."

After a lively 40-minute discussion of adding and subtracting positive and negative numbers, the third graders divided up into groups of three to work on the mimeographed mystery number assignment. Within a few minutes, several of the groups discover it is unsolvable. Regathering as a large group, the teacher asks what her pupils thought of the problem. A few seem angry that the problem has no solution--one pupil even calls it a "foolish joke." Most of the pupils seem unperturbed and several suggest changes in the directions that would enable them to find a solution.

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[1]Paper presented at the annual meeting of the American Educational Research Association, San Francisco, April 1989.

[2]G. Williamson McDiarmid, associate professor of teacher education at Michigan State University, is associate director of the National Center for Research on Teacher Education. The author gratefully acknowledges the contributions of Deborah Ball, whose ideas and suggestions shaped both the field experience herein discussed and the author's understanding of mathematical pedagogy, Ball's third graders and her teaching partner, Sylvia Rundquist, at Spartan Elementary in East Lansing, Michigan. He wishes to acknowledge the assistance of the students in his Exploring Teaching course and his colleagues who have, over the years, contributed to development of this course and his understanding of the question it engages, including Joyce Cain, Helen Featherstone, Sharon Feiman-Nemser, Susan Florio-Ruane, Magdalene Lampert, Susan Melnick and Suzanne Wilson.

After the bell rings signaling gym class, a few of the university students, feeling the discussion they witnessed supported their initial belief that the pupils should not be given the worksheet, ask the teacher if she thinks she did the wrong thing and she responds:

> *I don't know. On the one hand, pupils like Ahmed who take a lot of satisfaction from solving puzzling problems, were upset. But, as you saw, most of them took it in stride. And it became an occasion for us to talk about operations with positive and negative numbers and whether or not zero is positive or negative. The question for me is what may pupils understand now about positive and negative numbers that they may not have understood before.*

The primary value of this incident lay in its power to force my students to voice and reconsider one of their many unexamined beliefs about teaching (which I discuss below). In discussing the use of the flawed assignment, students manifest their beliefs that teachers should protect children from confusion and that young children are not capable of figuring out difficult problems for themselves--two strands in a web of beliefs about teaching. The field experience that is part of my Exploring Teaching course is structured so that students will encounter evidence calculated to challenge these unexamined beliefs and orientations.

Early field experiences which have been the rage in teacher education for over a decade and half or so (Waxman and Walberg, 1986) are rarely occasions for prospective teachers to confront their web of beliefs about teaching. Rather, such experiences are frequently mere extensions of what Lortie (1975) terms "the apprenticeship of observation" and serve principally to reinforce these beliefs, understandings, and attitudes--to reinforce what Buchmann (1987) has termed the folkways of teaching, "ready-made recipes for action and interpretation that do not require testing or analysis while promising familiar, safe results" (p. 161). Learned by "tradition and imitation" and authorized by "custom and habit" (pp. 154-155), the folkways provide prospective teachers with orientations that accord with their experience of schools and also seem to work.

The Role of Early Field Experience

Early field experiences can be seen as a response to charges by policymakers, teachers, and teacher education students that teacher education programs are too abstract and academic (Waxman and Walberg, 1986; Webb, 1981). According to this point of view, the practical and the theoretical in introductory courses will be brought into closer alignment if students are exposed to high doses of "reality"--that is, observing, assisting, and teaching in classrooms. Moreover, early field experiences will alert prospective teachers to the relevance of subsequent education courses, thereby addressing what Katz and her colleagues (1981) have termed the "feedforward" problem; that is, beginning teachers tend to believe they were not taught essential knowledge--for example, knowledge about how to manage a classroom--regardless of whether or not they were actually exposed to the information. When asked how the quality of their preservice program could be improved, recent graduates offer suggestions like the following: "more hands on experience . . . more field experience . . . more student teaching . . . more practical experience . . . more practical applications . . . gear more to practical concerns . . . more experience in schools . . . a wider variety of school situations . . . " (Fotiu, Freeman, and West, 1985, p. 15). The explanation offered for this phenomenon is that as students, prospective teachers do not see the relevance of much of what they are taught and, consequently, do not attend to knowledge for which they have no immediate need.

Teacher educators who teach introductory courses with a field experience face a dilemma: On the one hand, experiences in school classrooms are memorable and powerful and are considered eminently credible by prospective teachers; on the other hand, such experiences are fraught with pitfalls, not the least of which is that what students see serves largely to confirm their faith in the folkways of teaching. As Feiman-Nemser and Buchmann (1986) have written:

> These pitfalls [of experience] arrest thought or mislead prospective teachers into believing that central aspects of teaching have been mastered and understood. Premature closure comes from faulty perceptions and judgments that are supported, even rewarded, by trusted persons and a salient setting. . . . What makes these perceptions pitfalls is that future teachers get into them without knowing it and have a hard time getting out. What makes them even more treacherous is that they may not look like pitfalls to an insider, but rather like a normal place to be. (p. 71)

What Do Beginning Teachers Believe About Teaching and Learning?

As an educator of beginning teacher education students, I have become familiar with the web of beliefs that the mostly white, mostly middle-class, and mostly female students bring with them to introductory teacher education courses. Research on prospective teachers attests to the prevalence of these beliefs (see Ball, 1988b; Brousseau and Freeman, 1989; Brousseau, Freeman, and Book, 1984; Feiman-Nemser, McDiarmid, Melnick, and Parker, in press; Fotiu, Freeman, and West, 1985; Freeman and Kalaian, 1989; Gomez, 1988; McDiarmid, 1989; Neufeld, 1988; Schram, Wilcox, Lanier, Lappan, and Even, 1988).

For instance, beginning teacher education students believe that teaching subject matter is largely a matter of telling or showing--the view of teaching prevalent not only in schools but in the broader culture (Cohen, 1988; Cuban, 1984; Jackson, 1986). They assume that, as an article of faith, every child is unique--or special--and deserves an education tailored to his or her particular needs (McDiarmid, 1989).[3] Consequently, most prospective elementary teachers believe different objectives and standards should be applied to different students (Freeman and Kalaian, 1989, pp. 23 and 28). Many prospective teachers believe some children are not capable of learning basic skills in reading and math (Brousseau and Freeman, 1988; Freeman and Kalaian, 1989). Half of them think that students are responsible for their own school failures: They lack either the right home environment, the right attitude, or the right ability (Freeman and Kalaian, 1989; Paine, 1988); that is, at least half of all prospective teachers are disposed to think that if children don't succeed, "it's their own fault."

For most prospective teachers, learning means committing to memory what they are told or have read, although their views may vary by subject matter. Not only did their high school and elementary experience convey this view of learning, but their experience in college courses--in both liberal arts and education--confirms it (Ball and McDiarmid, in press). They believe that learning depends on practice, since this will help pupils remember rules, procedures, and facts (Ball, 1989). The more practice learners get in spelling words, doing computations problems, choosing the correct adverb to fit the blank, answering end-of-the-chapter questions or worksheets and so on, the more they will learn.

Many prospective teachers believe that subject matter at the elementary level is "simple" (Ball, 1988b) and that they probably already know enough to start teaching *before they even begin their professional studies* (Freeman and Kalaian, 1989). Some methods and a little classroom management--that is, discipline--would be nice, but they feel they know enough about what they are going to teach and how (Fotiu, Freeman, and West, 1985). And where do they believe they will learn this bit they don't know? In classrooms. This belief is reinforced by veteran teachers who tell them the primary benefit of teacher education is the opportunity to do fieldwork (Fotiu, Freeman, and West, 1985).

Rather than challenging students' initial beliefs, teacher educators tend to focus on issues that they and their students' already agree on (Brousseau and Freeman, 1988). As a consequence, most prospective teachers complete their teacher education programs without having examined, much less questioned, their most fundamental beliefs about teaching, learners, learning, subject matter, and the role of context. I would argue, in fact, that teacher education students rarely become aware of the assumptions under which they operate. Instead, they either reconfigure ideas and information they encounter to fit their

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[3]The beliefs underlying folkways are not patently false. Indeed, most, like this one, incorporate crucial elements of empirical reality and moral commitment. Who but W.C. Fields-like curmudgeons would deny that "each child is unique?" This explains the power, prevalence, and tenacity of such beliefs. The issue for teacher education is: What are the pedagogical consequences of such beliefs? In this case, for instance, I would argue that this belief has served to justify the "tailoring" of opportunities to learn subject matter and of standards that have denied children of color and poor children equal chances to learn equal knowledge (McDiarmid, 1989). Apparently "good" beliefs about teaching, if examined, can and do lend themselves to perverse results.

initial beliefs and understandings--or they simply reject what doesn't fit. In this regard, they are no different from younger students (Resnick, 1983; Wittróck, 1986).

The Exploring Teaching Field Experience

To challenge the lessons of prospective teachers' past experiences with schools and teaching, I have tried to design a field experience that forced students to give voice--either in discussion or in writing--to their assumptions and what called their assumptions into question. In thinking about the field experience, I was guided by my knowledge of their opinions about teaching, learning, learners, subject matter, context, and learning to teach--that which constitutes a web of beliefs. For instance, the view that mathematics consists of rules and procedures is reinforced by the view that learning mathematics means remembering the correct algorithm and teaching involves giving learners lots of practice to help them remember and testing frequently to determine if they can get the right answers.

These views of the subject matter, teaching, and learning are interwoven with the belief that listening to other pupils' explanations and ideas is confusing, that finishing the textbook or covering the curriculum signals successful teaching, and that what children need, especially poor children and those of color, is to master the basic skills, meaning computation. A field experience intended to force prospective teachers to rethink their understandings of teaching and learning should, consequently, confront students' assumptions not separately but as the web they constituted.

Description Of The Experience

I arranged for the prospective teachers in my introductory course to observe, as a group, Deborah Ball, an experienced teacher, whom I knew taught in ways that were likely to challenge my students assumptions and beliefs. I chose her less because she "modelled" good practice and more because her practice played havoc with much that passes for conventional wisdom in teaching. Through the creation of a learning community (Schwab, 1976) in her classroom, moreover, Ball enabled all pupils--regardless of language or cultural background or gender--to participate on an equal footing in a conversation about mathematics that does not end and to voice their understandings relatively free of worry about ridicule from their classmates.

Before observing Ball's classroom, my students puzzled over, wrote about, and discussed the same piece of subject matter that Ball's third graders would be discussing: operations with positive and negative numbers. Before and after each class, they interviewed Ball about her purposes, goals, plans, her reactions to events and students, and her rationale for her behaviors. They observed her class discussing positive and negative numbers and working on problems together in small groups and, subsequently, responded in writing to specific questions about what they had observed (see Field Assignment #1 in appendix A).

Ball, my students, and I jointly developed a clinical interview that my students then used to explore the third graders' understandings of operations with positive and negative numbers (see Appendix B). They discussed with Ball pupils' responses to the interview in their effort to assess pupils' understandings. The prospective teachers then attempted to teach someone--a roommate, friend, or relative--about operations with positive and negative numbers. Finally, they wrote a "case study" of the teaching and learning of the subject matter (see Appendix C).

The entire sequence occurred over a four-week period and involved 4 hours of observation in Ball's classroom, another 4 hours of discussion with her, and about 10 hours in the university classroom. I'd like to describe in more detail each of these elements of the field experience, my rationale for each, and my students' reactions.

The University Classroom: Confronting What It Means to Understand Subject Matter

I chose to focus on mathematics because of prospective teachers' typical attitudes. Most prospective elementary teachers are not fond of mathematics and believe themselves lacking an aptitude for the subject (Ball, 1988a; Schram, Wilcox, Lanier, Lappan, and Even, 1988). One of my student's feelings and attitudes were shared by most:

> As a learner in Deborah's class I was not very comfortable . . . because I have always had a deep dislike for . . . math. When I was growing up and taking math classes I always did very well until high school where I went downhill and avoided it like the plague. When I walked into Deborah's classroom for the first time I wanted to continue to avoid it and try to observe without actually thinking about the topic. (VG)

Another student wrote:

> Mathematics is a subject ma[illegible] people love to hate. I can remember so many times in high school Algebra when the class looked forward to coming into the room to complain about why math was an impossible subject to learn. . . . Our teacher would simply walk in, demonstrate how to work through different problems, then assign us homework. . . . I am able to do math only because I am able to memorize rules. I have never been asked to understand the concepts of why a mathematical solution makes sense. (CJ)

Finally, many of my students do not see any value in learning mathematics:

> In my eyes, mathematics was useless. I could never understand where in my lifetime I would ever use math formulas again. In a checkbook? On a resume? What was the purpose of learning it? From the beginning, my

understanding of math was to memorize the laws and formulas to get the answer. I didn't have to know the concepts of math. I didn't even know mathematics *had* concepts! (JZ)

At the same time, they don't believe their dislike for mathematics or their lack of aptitude is a handicap because the mathematics they need to know is simple: addition, subtraction, multiplication, division, fractions, decimals, ratio, percentages and so on (Ball, 1988a). Prospective teachers conclude that they can safely depend on the mathematics learned in school and in college and can focus on methods. I reasoned that if I could get my students to realize the inadequacy of their knowledge of mathematics for teaching even young children "easy stuff," I could convince them of the importance of a genuine understanding of all subject matters for teaching.

In choosing a topic to study, I wanted as simple a piece of mathematics as I could find. Fortune once again smiled on me: During the time my students would be visiting her class, Ball planned to work on operations with positive and negative numbers. This seemed ideal: My students would almost certainly feel confident about their knowledge of this topic.

During the fifth class of the term, we talked about the kind of teaching and learning they had experienced previously in school and college, comparing their recollections with the teaching they had seen in Ball's classroom during the first day in the field. They prepared for this discussion by reading about operations with integers in a mathematics methods book recommended for its conceptual explanations. I also asked them to solve the equation $-8-(-2) = ?$ and to explain in writing what they understood this answer to mean.

For many, the experience was unnerving. Most were unaccustomed to explaining their answers. As one student wrote, "The answer is -6 but I don't know why. I was taught that when you subtracted a negative number, it is just like adding a positive. That's all. I don't know why it works." In class, a student volunteered to read his explanation. He came to the front of the room, wrote his answer on the board, and stated that subtracting a negative is the same as adding a positive. When someone asked him why, he repeated his first explanation, more slowly--a technique he no doubt learned from observing his own teachers.

"I still don't get it," complained a student. "I mean your answer is the same as mine but your explanation is just the same thing I was taught in school. Why is it -6 and not -10?" Frustrated, the first student drew a number line on the board--an idea he subsequently admitted he got from his first day observing in Ball's classroom when several of her pupils used the number line to justify their answers. Pointing to the negative 8 on the line, he explained that "taking away" negative 2 means moving towards zero.

Consternation deepened on many of the faces in the room.

"Why do you move toward zero on the number line?"
"Aren't you taking away even more?"

"Wouldn't the answer be more negative?"
"What's a number line? How does that 'explain' this answer?"

The first student looked from the number line to the questioners and shrugged his shoulders.

When I asked if anyone had another way of explaining the answer, a young woman came forward and drew a circle. In the circle she drew eight negative signs and crossed out two of them. "Let's say you have eight negative markers in a bag. If you take away--subtract--two of them, you'd have six negative markers left." This was the example used in the methods textbook my students had read. Several of those visibly puzzled by the number line example unfurrowed their brows.

After she answered some of the questions put to her, I asked the class, "Did anyone come up with a story that would represent what negative 8 minus negative 2 means?" After a long silence, a student said, "I don't know if this works exactly but here goes: Suppose a South American country owed U.S. banks $8 billion and the banks decided to cancel $2 billion of the debt. That would leave $6 billion in debt." This example provoked a lot of discussion because the Latin American debt issue had recently been featured prominently in the news and because this was the first "real world" application that anyone had suggested.

Most of the discussion focused on whether the banks were actually contributing something (i.e., adding a positive) or taking away from a negative and how important the distinction was mathematically and politically. As class ended, someone was making the point that deciding whether this was addition of a positive or subtraction of a negative might depend on point of view--the debtors might construe it one way and the creditors the other. We had spent over an hour discussing one "simple" problem: $-8 - (-2) = ?$

In reaction to this class, one student wrote:

> Learning about integers and operations with negative and positive numbers in this class taught me how much I do not know! My background in math goes up through calculus and I had trouble with several of the concepts we touched upon. There is a difference between learning the rules and really visualizing and understanding what is behind those rules. (ML)

Another student described her experience as follows (her use of "theorem" here illustrates the difficulty students have in finding language to describe their understandings):

> When I first learned about positive and negative integers I was given a bunch of theorems and taught to apply those theorems to the problems we were given. . . . I was never asked how the theorems were derived. . . . I got my answers because that was how the rules said to do it, and that was that. When I learned about positive and negative integers this second time, in our class, I

had to support my answers with ideas other than theorems. If I tried to explain it with a theorem, I was asked to explain how I got the theorem. So I, like the students [in Ball's class], not only had to understand my answer, but the answers behind the theorem too. . . . At first I had a hard time explaining my answers without saying "that's just the way it is," but the more we discussed it in class, the more I began to analyze it. (MK)

The Field Setting: Confronting Beliefs About Learners, Learning, and Teaching, and the Role of the Context

The discussion described above forced my students to confront their notions about what mathematics is and what it means to do mathematics. Most thought that mathematics was a body of rules and procedures to be remembered and appropriately applied and that doing mathematics meant solving computational or word problems by yourself. As the comments above indicate, students confronted other dimensions of teaching, particularly their views of themselves and others as learners, their understanding of the learning process, their assumptions about teaching, and the role of others in that process--classmates and teacher.

Their observations in Ball's third-grade classroom further forced them to consider their views of learners, particularly young learners, the learning process, and teaching. To describe a typical class, I will crib from one of my students. Note that this individual's observations have been supplemented by the discussions students had before and after each class with Ball:

> Deborah uses three types of forums. First, there is what I call individual study time. Second, there is what I call group discussion. Lastly, there is what I refer to as partner work.
>
> During individual study time [at the beginning of each class] students are given a problem to work on individually. For example, on October 26th, the problem that students worked on was as follows: "1) Write down at least ten numbers. 2) Then add 20 to each number. 3) Now circle all the answers that are even."
>
> This individual study time allows each student the opportunity to think about the problem and practice skills individually with limited influence from other students and from Deborah. Deborah utilizes this time period to assist students that have questions, and to motivate students that are having problems getting started. . . .
>
> During the group discussion time students are given the opportunity to share with the class answers to the problems that they worked on individually. It appears that initially each answer is treated with the same degree of validity. That is, Deborah does not tell the student whether the answer is correct or incorrect. Deborah allows the rest of the students an opportunity to challenge all answers given. Deborah stresses that it is essential to ask for challenges to all answers. This will not prejudice any response and will not discourage

students from participating because they fear the may have a wrong answer. Another point that Deborah stressed about challenges to her students is that it is not acceptable to say, "No way!" when a challenge or answer that seems incorrect is given. This was made clear when Hilary made a challenge that was incorrect, a large number of students said, "No way!" to Hilary's statement that 11 + 20 = 21. . . . Deborah is concerned with keeping a mutual respect among the students. Perhaps a mutual respect will allow students to learn and understand math without being concerned about taking risks of giving incorrect answers. . . . [This approach] will enhance curiosity about math that will encourage them to ask more questions and thus allow them a greater understanding. . . .

Another important aspect of discussions is the right of revision that each student has. If a student is convinced by others in the class that the answer they have given is incorrect, the student has the opportunity to revise their answer . . .

In partner work Deborah has paired the class into groups of two students. . . . During my interview with Brian he said that he liked working with partners the best because this gave students the opportunity to help each other. Brian's observation is very important because in essence what he is saying is that in some cases peers are able to help each other understand mathematics better than the teacher can. Possibly Deborah recognizes the importance of what Brian has said. In the three forums that she has created she has placed a great degree of emphasis on peers helping one another. In the group discussions her role is basically one of motivating class participation, she tries to get the students to direct conversation towards one another and not towards her. . . .

Something else that is important to Deborah is that her students learn that what mathematics consists of is people getting together and agreeing on conventions. . . . During the first few minutes of discussion [of the problem described above] there was a rather extended debate as to what "at least" meant [in the sentence, "Write down at least ten numbers"]. Hilary said that she thought in this situation it means that she could only use ten numbers. Ivy challenged her and said that it meant you could write ten or more numbers. The majority of the class agreed with what Ivy said. (MC)

This experience required my students to reconsider what it means to teach something. Most of them believed that the teacher's role is to tell, show, or explain procedures, facts, ideas and so on. While Ball told children how to behave--how to disagree with someone, for instance--and how to go about an activity, she rarely told them whether answers or representations were wrong or right. Rather, she created and encouraged discussions about problems in mathematics. To illustrate her teaching, one student recorded her utterances during a brief exchange with her pupils:

Find a sentence [you wrote] that you want to talk about.
Dan, explain your sentence and how it works.

[Other students start to raise their hands and interrupt Dan while he is responding] Quiet down.
Does anyone else have any ideas or challenges?
Why does or doesn't this sentence make sense? Can anyone give me some reasons?
Dan, would you like to revise your explanation?
Does anyone have any suggestions? (DJ)

Several students remarked that she frequently redirected her pupils' comments away from her and towards the individual whose idea was being discussed. They also noticed how Ball both developed her pupils' ability to reason about mathematics and enabled them to "save face":

> When an answer was given, Deborah did not say whether it was right or wrong but instead encouraged her students to challenge one another. If Deborah sensed a student was heading in the wrong direction, she would ask them if they wanted to "revise" what they had just said instead of simply telling them that they are wrong. By doing this, she was allowing them the opportunity to THINK through what they had just said and perhaps realize their mistake. (CJ)

My students noted how this encouraged pupils to continue participating and communicated to them that doing mathematics was a thoughtful activity facilitated by the ideas and feedback of others.

My students may have been most surprised by the level of discussion and debate among the third graders they observed and interviewed. Believing that young children don't know much and aren't capable of understanding complicated ideas, they expressed surprise at the level of intellectual sophistication (Kohl, 1984) they encountered:

> I was amazed by how well Deborah's students understood positive and negative integers. The students were all basically enthused about discussing the math problems and their explanations for their answers were all thought [through]. When Deborah gave students a problem to do that had no correct answer [a reference to the Mystery Number problem described at the beginning of this paper], I was surprised by how quickly the students realized this and by how many of them knew what was wrong about it. . . . Lawrence and his partner had already figured out that something wasn't right about it within the first five minutes . . . . Another girl approached Deborah, telling her the problem wasn't possible and exactly why it wasn't. The students knew they could make a mistake and that is why they weren't afraid to challenge others, even the teacher's math ditto. (MK)

In particular, the prospective teachers were impressed by the third-graders' use of representations in their discussions. After describing how different pupils had used the number line, bundles of sticks, and the minicomputers[4] to substantiate their answers, one of my students observed, "The way I saw these tools used was not as learning devices, but as tools to help the students explain their answers" (SH).

Believing part of the teacher's role is to praise and correct pupils, they were not prepared for the lack of public evaluation in Ball's classroom. As one of my students explained,

> Even wrong answers and strange explanations are discussed because they might bring up an interesting subtopic or an area of confusion for the class, such as the properties of zero [the university students observed a lengthy debate as to whether zero was odd or even]. They are also discussed to show that speaking up in class is accepted and good. Her students are taught to evaluate their own answers and others' answers which is a valuable skill for any subject and can be extended to everyday problems. (RC)

In group interviews with Ball after the observations, my students asked her how she could cover the district curriculum for third-grade mathematics if she spent several days or even a week on the same problem. In response, Ball then asked them to consider the various topics that her pupils had considered in their discussion of integers: addition and subtraction, even and odd, the nature of zero, ratio and proportion, estimation and mental calculation, and so on. Her pupils, in figuring out a single problem, had used many of the ideas and operations that constitute the third grade curriculum. Because of their own experience in discussing $-8 - (-2) = ?$ in our classroom--a discussion that involved them in thinking about the relationship of subtraction to addition, as well as the nature of numbers--the university students could readily credit Ball's claim.

They also noted the importance of the "community" of the classroom Ball created around the learning of mathematics. The focus of the community was understanding mathematics. While Ball communicated and displayed both affection and concern for her pupils--and they for her--these sentiments fortified the community but were not its basis. The following excerpt reveals one of my student's effort to grapple with the connections among the classroom context, pedagogy, and subject matter:

[4]The minicomputers, produced by CEMREL as part of its Comprehensive School Mathematics Program, were developed by a Belgian mathematician, Georges Papy. They are 8 1/2" x 11" pieces of cardboard on which are printed two equal squares each of which is subdivided into four squares of different colors. Each of the smaller squares represents a number; students places various combinations of positive or negative markers on these squares to represent numbers. In addition, the squares can be used to represent place value.

> Discussion, then, allows the students as a "community" to express their ideas and thoughts amongst themselves, and through the challenge method come up with agreement as to what could be possible hypotheses or theorems in accordance with the content that is being covered. (LD)

Encountering a classroom community built around a mutual engagement with content is an occasion for prospective elementary teachers to confront what 9 out of 10 claim is their primary reason for teaching: Love of children. Kohl (1984) distinguishes between loving all students and loving students as learners. He argues that love is not boundless, that teaching is but a part of one's life, and love engages "all parts of one's life," and that "it isn't possible to love so many people you know so little about and will separate from in six months or a year" (p. 64). Teachers do, however, argues Kohl, "have an obligation to care about every student as a learner" (p. 66).

Students also noted how Ball's approach enabled children from a variety of cultural backgrounds and females as well as males to be a part of the conversation and the community. A student who interviewed a Chinese pupil who joined the class after the school year began noted that, although unsure of herself and limited in her ability to express herself orally in English, she could do and explain the problems on the clinical interview and she "enjoys Deborah as her teacher, the class as a whole and she loves mathematics" (WW). Others noted the lack of grouping by ability and the fact that children from a range of cultures--Zimbabwean, Chinese, Pakistani, as well as several in the United States--participated in discussions and communicated directly with each other about their ideas.

A major topic in the Exploring Teaching course is how differentiation within schools and classroom results in different students learning different subject matter, which prepares them for different futures in school and society. Poor students and those of color are more likely than are white middle class students to find themselves in low reading groups and in general vocational tracks. Most prospective teachers who attended large comprehensive public schools benefit from ability grouping and from being members of the "college" track; consequently, for them ability grouping and tracking are part of the natural order. Ball's use of groups organized on bases other than ability--such as students' preferences or her judgement about mutual compatibility--presented an occasion to discuss the uses and effects of ability grouping.

Trying to Get Beyond Rules and Procedures: Teaching and Telling

After wrestling with mathematics in their university classroom, observing third graders deal with the same content, interviewing both the teacher and the pupils, the beginning teacher education students now had to teach someone else subtraction with negative numbers using their new-found understanding. This presented students an opportunity to confront their assumptions about teaching and learning, as well as their views of mathematics, deeply embedded in our culture.

Some students found their understanding inadequate to the task:

> I started off by having my college-age roommate explain to me what negative and positive integers meant to her. She automatically referred to the number line, indicating that the numbers on the right of zero were positive and the numbers on the left were negative. Then I proceeded with some problems: 8 + (-4); -8 +(-4); -8 - (-4); 8 - (-4). In the first problem there was no real difficulty. We figured out the problem, and I used the number line to substantiate the answer. The farther we got in the problems the harder it became for me as a teacher to explain without using the saying, "It's a rule, that's why!" From this experience I learned I need to become more acquainted . . . with different ways of explaining without just stating rules. (RL)

Most students, like this one, still thought their role was to explain or show the learner their rationale for the answer, not to draw forth the learner's understanding. Even students who noted that Ball enabled her pupils to develop their own rationales for their ideas reported that, faced with a similar situation, they, not their learner, explained the answer:

> I worked with a friend of mine, Monique, and told her that I needed her to help me with a project. I explained to her that we were going to work with subtracting negative numbers and she jokingly said, "Fine." I then proceeded to give her a problem, "What is -6 - (-2)?" She readily responded, "Negative four." When asked why, she said, "Well . . . because . . . when you subtract a negative it is just like adding a positive and -6 + 2 is -4."
>
> I then asked her, "Why?"
>
> She looked at me rather perplexed and then said, "Well, because it is!"
>
> I asked again, "Why? I don't understand, how does the rule work?"
>
> I could tell as this point I was upsetting her so I explained to her how we get so misled by learning rules without reasoning. I then proceeded to explain how this could be shown. I drew a circle and put six "chips" in it and told her all the chips in the circle were negative. Then, I told her we were going to subtract two negative chips from the six and asked her how many negative chips were left.
>
> Again she replied, "Negative four," but this time she understood why. (WW)

Also evident in this response is the persistent tendency to confuse teaching with what Ryle (1949) terms a "task verb" and teaching as an "accomplishment verb."

Some students did resist the temptation to tell and get it over with. One, after describing how she had worked with her roommate, asking her learner to show her on a number line why she thought -8 - (-2) = -6, eventually getting her to articulate her understanding of subtraction, wrote the experience "helped me realize that it can be frustrating, because you want to tell them how to do it, but it is also rewarding because you lead them to the answer and I was able to get her to realize that her first solution was faulty [and] she went back and revised it" (ML). Another wrote: "While I was teaching Devon, my feedback to him consisted of answering his queries as if his answer was right. When he was giving his reasons, I resisted the strong urge to give him a way to represent his ideas" (RC).

The dominant theme that emerged from students' descriptions of their attempts to teach operations with positive and negative integers was, however, their realization of the relationship between their own understanding of the concept and their capacity to help someone else understand. One student who felt she had muffed her first effort but succeeded quite well as her own understanding developed during her second attempt wrote, "it became evident that I could not teach concepts that I did not myself understand." Another wrote of her effort,

> I went on to show [the learner] the chips model in the handout [taken from the mathematics methods text]. This only added to the problem because we both became confused. We worked with the chips model for some time but did not accomplish any more. . . . This experience showed me the importance of knowing and being able to express verbally both the how and the why of these problems and concepts. (TJ)

Realizing that they lack an understanding of seemingly "simple" subject matter is unsettling for some students, particularly those who are about to graduate and cannot grasp at the hope that somehow their remaining university courses will provide them with the knowledge and understanding they lack.

Assessing What Prospective Teachers Learn From Field Experiences

How do I know that this field experience forced my students to confront their initial beliefs and conceptions and begin to change them? I don't. I do not wish to imply that I am content with my uncertainty, yet the only reliable test of changes in belief is what these students will do in their own classrooms. In the meantime, I must content myself with what I can infer from the discourse in my own classroom and from students' written work. Like Deborah Ball, I try to create a classroom where students are comfortable expressing their beliefs, doubts, puzzlements, and understandings, whatever they may be, and in which they are equally comfortable changing these beliefs and understandings. Unless I know what my students are thinking, what ideas, experiences, and beliefs they bring with them, as well as what they understand about the ideas and experiences they encounter in the course, I will make decisions about means and goals blindly. Knowing that not all students are comfortable discussing their views and understandings publicly, I use "fastwrites" (impromptu, five-minute, unproofed written reactions to questions or statements), responses to study questions on the readings, and formal papers as other sources of information on my students' thinking.

For those among my readers who pride themselves on being hard-nosed, I will conclude with some sample responses to a question on the final examination. To prepare students for this question, they watched a videotape of a teacher teach his fourth graders operations with integers. This teacher, who we called "Bob," conformed closely to the view of good teaching most of my students brought with them to Exploring Teaching: He stood at the front of the room, exuding confidence and organization, wrote math problems on the board, maintained pupil attention, asked questions for which right and wrong answers existed, explained solutions, used a representation--the Logo "turtle" on a video screen--of operations with integers that was both high tech and arguably interesting to fourth graders. I chose Bob for my students to observe because he conformed closely to many people's notions of an effective teacher. Here, I thought, is a teacher very like the teacher many prospective teachers aspire to be.

On the final, I asked them to compare Bob's and Deborah's goals, hidden curriculum, opportunities to learn, as well as their representations of operations with integers (see question 1 on the final exam included in Appendix D). I reasoned that I could gauge their understanding in a crude fashion by their ability to identify and discuss the issues raised by the representations used in each classroom. Finally, I asked them to speculate on the sources of the differences they saw between the two teachers.

Below, I provide examples from the range of responses I received.

> Bob's representation of subtracting negative numbers involved the use of the computer and the Logo "turtle." Each step in the problem was seen as a command for the turtle to follow. If the problem read 8 + (-5), we would break it into parts and commands for the turtle to get our answer,
>
> | | | |
> |---|---|---|
> | 8 | = | Move the turtle in direction [turtle is] facing |
> | + | = | No change in turtle direction |
> | - | = | 180 degree turn in turtle's direction |
> | 5 | = | Move five spaces in direction [turtle is] facing |
>
> . . . .
>
> 0 1 2 3 4 5 6 7 8 9 10
>
> If we were to do the following problem:
>
> 8- (-5) = ? we would do the same procedure with our turtle.

8 = Move eight places in the direction [turtle is] facing
- = 180 degree change of direction
- = 180 degree change of direction
5 = Move five places in the direction [the turtle] is facing

. . . .

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

> In doing the problem this way, we got the right answer but do we know why? Is it only because that is where the turtle stopped? And will this tool be useful if we had a much larger number? Could the kids still move the turtle 115 spaces . . . and then change directions and go 85 spaces (i.e., 115 + -85)? It soon becomes too complicated to use. (BH)

As a teacher educator, I find this response encouraging because of the focused, thoughtful analysis of the representation that reveals evidence of emerging pedagogical judgement. Teachers must judge the value and appropriateness of various representations of the subject matter at their disposal--textbooks and other materials, computer software, activities, stories, analogies, examples, manipulatives, and so on (McDiarmid, Ball, and Anderson, 1989). In making such judgments, teachers draw on their knowledge of not merely the subject matter but of their learners--their prior experiences and understandings--and the learning process, as well as of the context of the school and community. In this particular response, the student brings to bear both his understanding of mathematics and his sense of the computer's practicality as a tool for helping pupils understand this piece of mathematics.

Bob also referred to "Eli's magical peanuts" in explaining subtraction of negative numbers. Apparently this representation is much like that used by the student in my class who explained subtraction by taking negative chips out of a circle. One of my students criticized this representation:

> This [representation] gives a sense of mysteriousness about math to the children. Deborah's idea of math was more concrete with her use of many tools. She used the minicomputer, the number line, and the bundles of sticks to represent numbers and operations. These gave more meaning to the kids. She used these tools as evidence. (VG)

As for the turtle, this student wrote:

I did not like this representation because it strictly involved memorizing rules and there is no emphasis on the process [of getting answers]. In Deborah's class she made sure the kids would justify their answers. . . . Ahmed once said that the answer was "getting more negative" and this to me displays more of an understanding than using the turtle. The turtle was also a bad representation because it didn't have any negative numbers on it and the number line only went up to 8.

Students also criticized Bob for being the arbiter of representations:

> Bob, "the authority," said, "I don't think that this is a good model to use," referring to Eli's bag of peanuts to solve the problem, 5 - (-3). However the students in Deborah's class were encouraged to use any method of solving a problem that made sense to them, including the number line, the minicomputer boards, et cetera. I have learned through Deborah's class that each student is capable of learning and that there are many ways to represent [concepts] so that all levels of ability have an opportunity to learn. . . . Bob, not having a complete understanding of the concept of negative integers, limits possible representation models. (DW)

Finally, in speculating on the differences between the two classrooms, students wrote about differences they thought they detected in the two teachers' knowledge about learners and about mathematics. As one student noted, when "Bob attempted to use his computer to show that two 'negatives' make a 'positive,' he completely forgets the fact that one of those 'negatives' was actually a subtraction sign instead. He, therefore, demonstrated 5 + [-(-3)] rather than 5 - (-3)" (JS). Another pointed out that telling pupils that the turtle turns 180 degrees whenever it encounters a negative sign "is just another way of saying that ' - + - = + '" (ML). And, yet, Bob fails to understand that this representation is not conceptual but procedural.

That prospective teachers, at this early stage in their professional studies, can discuss the pros and cons of various specific representations of a mathematical concept, can generalize about the characteristics of appropriate representations, can see the importance of multiple representations to create access to the subject matter for all children seems to indicate that they have begun to think about what teachers need to know about learners, subject matter, and pedagogy.

Reflections

In thinking about this course, the primary question that occurs to me is whether such a focused, indepth experience with one topic in mathematics taught by an atypical teacher in a single third-grade classroom can have much effect on the way beginning teacher education students think about teaching other subject matter to other learners in other settings. In discussions and in their papers, I encountered evidence of students' resistance to generalizing the lessons of their experience in Ball's classroom: Some students claim that Ball's pupils must be gifted; others claim that the school's proximity to the university makes it an atypical setting (many of the pupils' parents are students at the University) and explains why Ball is able to achieve what she does; still others claim that Ball's knowledge of mathematics or of children is exceptional and beyond the capacity of other mere mortals. Except for the assumptions that the pupils are gifted--by several standards, they appear no more so than most third graders--the other claims are not totally unwarranted. For students intent on keeping their beliefs and orientations intact, these claims are their refuge.

For those students who are willing to revise their understandings and beliefs about teaching, I also wonder about their capacity to transfer the lessons they learned about the teaching and learning of mathematics to other subject matters. Do they come to see spelling instruction--and such drills exercises in pure memorization and free-floating, contextless memory bites of language--or vocabulary drill--in a new light? Do they think children are as capable of making sense of the Freedom Rides as they are of making sense of -6 - (-4)? Do they understand that ability grouping, however sanctioned by time, custom, and folk wisdom, is as discriminatory and invidious in reading as it is in math?

Students who realize the inadequacy of their knowledge in most subjects lose much of the blithe confidence they exhibit at the beginning of the term. Asked to analyze their knowledge for teaching and to speculate on how and where they might learn what they feel they lack, many nonetheless exhibit an abiding faith in their college classes:

> If I were to take Deborah's place in teaching integers to her third graders I would need to know a lot more about the subject matter. I could learn more about positive and negative integers if I were to take some mathematics classes in college. (LD)

Evidence that prospective teachers' liberal arts and professional courses will afford them the opportunity to develop the kind of subject matter understanding that Deborah Ball demonstrates is lacking (Ball and McDiarmid, in press). If anything, the evidence on college classrooms indicates that teaching and learning are just as mechanical, disconnected, and fragmented at this level as they are at the precollegiate level (Bennett, 1984; Boyer, 1987; Kimball 1988, 1986; Kline, 1977; McDiarmid, in press).

Despite our discussions about the *kind* of knowledge needed to help pupils develop understanding of critical concepts, some students persist in believing that *more* knowledge (read "*more* courses") will furnish the understanding that they feel they lack. In part, they continue to believe this because, as proponents of the power and rectitude of schools, they associate knowledge and learning with formal course work; in part, future courses represent a hope they can cling to--a hope that has vanished for the seniors Deborah Ball teaches in her mathematics methods course (Ball, 1989). Many students leave Exploring Teaching aware that their subject matter understanding is insufficient but confident that exposure to more college courses will rectify the problem.

Yet, one theme in our discussions was the almost complete lack of attention their liberal arts professors paid to students' understanding of the subject matter. Trapped in large lecture classes, subjected to tedious textbooks, and faced with multiple-choice exams, students expressed frustration with the kind of knowledge they had the opportunity to learn. Whether their awareness of how mechanical and disembodied learning and teaching in most university courses are was translated into demands for different approaches to teaching, I don't know. That many of them recognize what they are presently learning will be of little value in teaching does, however, seem to justify confronting their unexamined beliefs. Some may do something about it: seek out smaller courses run as seminars, such as those typically found in honors colleges at large universities; demand more explanation and discussion in their courses; create study groups in which they can talk about key ideas in a course; reflect on their own understanding to judge whether or not it is sufficient for teaching.

For these students who are near the end of their college career, confronting them with how little they know and understand may appear even less justified. Teachers do, however, learn and gain understanding of their subject matter on their own. Critical to such learning may be recognizing what constitutes genuine understanding for teaching. That is what our struggles with -6 - (-4) are intended to do.

Yet, despite abundant evidence that prospective teachers do reconsider their initial beliefs and orientations, that they begin to understand the folkways of teaching they have learned are not merely unreflective but, in some respects, downright damaging, I am skeptical about the effects of the course. Like the web of the great spider Shelob in Tolkien's *Lord of the Rings* (1965), the strength of each individual strand of belief--about teaching, learning, learners, subject matter knowledge, and context--is formidable. But interwoven as they are, the various strands constitute a web of remarkable resilience; severing one strand barely diminishes the overall strength of the whole. And I feel often like Samwise Gamgee, Frodo's Sancho Panza, attacking the web:

> "Cobwebs!", he said. "Is that all? Cobwebs! But what a spider! Have at 'em, down with 'em!"
>
> In a fury he hewed at them with his sword, but the thread that he struck did not break. It gave a little and then sprang back like a plucked bowstring, turning the blade and tossing up both sword and arm. Three times Sam struck with all his force, and at last one single cord of all the countless cords snapped and twisted, curling and whipping through the air (pp. 420-421).

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Appendix A

COURSE SYLLABUS, READINGS AND FIELD ASSIGNMENTS

TE 101 - EXPLORING TEACHING
Section 1
Fall 1988

Bill McDiarmid
116L Erickson Hall
355-9302 (office)

Seminar: Mon., 1:50-3:40
Room 308 Natural Resources

Field Days: Wednesday

Office hours: 4:00-5:00 Mondays
or by appointment

Purposes of the course

This course is designed to help you begin thinking about teaching in new ways. As a pupil in elementary and secondary school, you have formed ideas about what teaching is like, what schools are for and what teachers need to know. Now that you are thinking about becoming a teacher, you need to examine your assumptions about teaching and schooling and consider what it takes to teach so that children learn and understand.

TE 101 is a time to clarify and test the seriousness of your commitment to prepare for teaching. This is not a course in how to teach. Instead, TE 101 is an opportunity to reconsider what teaching should try to accomplish and what kind of learning teachers should foster. You should gain a new understanding of the challenges and complexities of teaching and a better idea of what you need to know in order to become an effective teacher.

Overview of the course

The course is organized around three questions:

(1) What are schools for?
(2) What is classroom teaching like?
(3) What do teachers need to know to teach?

The first question focuses on teaching as a form of work carried out in a particular institutional setting--the American public school. What are schools for? What do students really learn there? Do teachers, students and parents want the same things from their school? How do the multiple and often conflicting purposes of school affect what teachers do and what they ought to do?

The second question focuses on classroom teaching. How can you tell when teaching and learning are going on? How do teachers manage the needs of individuals with the needs of the groups? What can teachers do to foster different kinds of learning?

Finally, we will examine what teachers need to know and how that knowledge is acquired. How important is subject matter knowledge? What can teachers learn from firsthand experience in classrooms? How much of teaching is common sense and how much depends on a body of professional knowledge?

Course requirements and grading

Attendance and participation. Because the course will be run as a seminar, your participation in discussions is important not only for your own learning but also the learning of others. Discussions will draw on readings, films, personal reflections and field assignments. What you learn in this course will be influenced by the degree of serious engagement in these discussions. Because of the central role that classroom discussions play in the course, attendance and participation will influence your grade.

Attendance at the four scheduled field days and completion of field assignments. You will spend four days as a participant/observer in an elementary classroom. Each time you will have a field assignment to complete. These assignments are designed to help you gather data about important aspects of life in classrooms.

Field experiences will take place at Spartan Elementary School on the MSU campus. Your are expected to meet at the school at 12:00 on the four Wednesdays indicated on your syllabus.

Study guides. We have developed study questions for each set of readings to help you focus on important ideas and make connections. Even though the study questions will not be graded, your instructor will read and respond to your answers. A percentage of your final grade will be based on your thoughtful response to these assignments.

In-class folders. Each student will have a folder that will contain "fastwrites," study question responses, and other in-class assignments. These folders will also be a way of communicating questions or comments to your instructor.

Papers. There are two papers. Your grade will be based on evidence of (a) basic understanding of the issue; (b) quality of connections drawn between and among the readings and class discussion; (c) clarity of written presentation. In preparing written assignments, pay careful attention to the topic as well as to the mechanics of writing (grammar, sentence structure, spelling, punctuation). The ability to communicate ideas clearly and appropriately is an important prerequisite for teaching.

Final exam. There will be an essay final exam during finals week. A list of questions based on the study guides will be distributed ahead of time.

Grading. Your final grade will be determined as follows:

Paper #1	20%
Paper #2	20%
Field Assignments	20%
Study questions	20%
Final exam	20%

Required Readings

Packet of readings available at Copygraph (at the corner of M.A.C. and Grand River, East Lansing). Copygraph's hours are Monday through Friday, 8:00 a.m.-8:00 p.m. and Saturday from 9:00 a.m.-4:00 p.m.

Note: Copygraph will print approximately 80-90% of the anticipated number of course packets needed for TE 101. Therefore, it is advisable to purchase your packet as soon as possible. Once the initial supply is depleted, you will have to pay for the packet and return to pick it up the following day.

Jackson, Philip. (1986). The practice of teaching. New York: Teachers College Press.

Kohl, Herbert. (1984). Growing minds: On becoming a teacher. New York: Harper & Row.

The books are available in the International Center bookstore or at the Student Bookstore.

READINGS
TE 101 - Exploring Teaching

Monday, October 3

Foreword to Growing Minds (by J. Featherstone)
Jackson, P. "The daily grind." (packet)
Suina, J. "And then I went to school."

Study Questions #1

Monday, October 10

Goodlad, J. "We Want It All."
Cohen, D. "The Common School: The Divided Vision"

Study Questions 2

Monday, October 17

Readings on probability (will be given out in class)
Florio-Ruane, S. "Creating Your Own Case Studies"

Monday, October 24

Hawkins, D. "I, Thou, It."
Paley, V. "Rulers."
Kohl, H. "Mastery of Content," pp 100-105.

Study Questions #3

Monday, October 31

Oakes, J. "Keeping Track, Part 1: The Policy and Practice of Curriculum and Inequality."
Oakes, J. "Keeping Track, Part 2: Curriculum Inequality and School Reform."
Featherstone, H. "Organizing Classes by Ability."
Letter to Editors of Harvard Educational Letter.

Study Questions #4

Monday, November 7

Begin reading Growing Minds.
Lampert, M. "How do Teachers Manage to Teach?"

Study Questions #5

Monday, November 14

Continue Growing Minds.
Jackson, P. "The Uncertainties of Teaching" and "Real Teaching" (Chapters 3 and 4)

Study Questions #6

Monday, November 21

Finish Growing Minds (especially "Teaching MacBeth and the Classics," pp. 141-148.)
McDiarmid, G.W. "Austin."

COURSE OUTLINE
TE 101 - Exploring Teaching

I. WHAT ARE SCHOOLS FOR?

Week 1: What Teachers Do/What Schools Are For

Mon., September 26 — Overview of course requirements; view and discuss films of Westside Prep and Central Park East, focusing on teachers' priorities and practices.

Week 2: The Hidden Curriculum

Where does the hidden curriculum come from? How does it shape what school is like for students? How does it combine with the explicit curriculum to determine the outcomes of schooling?

Mon., October 3 — Discuss hidden curriculum as reflected in films; consider particular difficulties that minorities have in mastering the hidden curriculum; why are schools and classrooms as they are?

Week 3: Conflicting Expectations

Mon., October 10 — What and whose purposes are served by schools? Can public schools adequately meet the expectations of various groups in society? Debate the Mozert v. Hawkins case.

II. TEACHING AND LEARNING

Weeks 3 and 4: Teachers, Learners, and Subject Matter

Mon., October 17 — Discuss operations with integers in class; discuss observation of Deborah Ball's classroom; discuss case study of teaching & learning.

Wed., October 19 — First field day: Meet at 12:00 with Deborah Ball in her classroom at Spartan Village Elementary School; discuss observing in her classroom; observe class; complete map of classroom.

Mon., October 24 — Discuss readings by Hawkins, Paley, Kohl; study questions #2 due. Discussion of teaching, learning, and subject matter, drawing from activities and readings.

Wed., October 26 — Second field day: Meet with at 12:00 with Deborah Ball in her classroom at Spartan Elementary; observe teaching of operations with integers.

III. TEACHING AND LEARNING IN CLASSROOMS

Week 5: Managing Individuals and Groups

Mon., October 31 Discuss dilemmas arising from managing time and space in the classroom; discuss academic learning time; what constitutes academic & non-academic?

Wed., November 2 Third field day: Meet with at 12:00 with Deborah Ball in her classroom at Spartan Elementary; observe teaching of operations with integers.

Week 6: Dealing with Diversity

Mon., November 7 Discuss pros and cons of ability grouping; discuss alternatives to ability grouping.

Week 7: Fostering Learning

Wed., November 9 Fourth field day; Meet with at 12:00 with Deborah Ball in her classroom at Spartan Elementary; discuss previous Wednesday's class; interview a pupil about operations with integers.

Before class on Monday, November 14, teach operations with positive and negative numbers to roommate, friend, or relative, taking careful notes.

Mon., November 14 Discuss relationship of teaching and learning as reflected in classroom lessons and pupil interviews; relate to Jackson's ideas about uncertainties of teaching.

IV. WHAT DO TEACHERS NEED TO KNOW?

Week 8: What Teachers Know and Where They Learn It

Mon., November 21 Generate categories of teacher knowledge from the readings, discuss how teachers acquire, develop and use different kinds of knowledge.

Mon, November 28 Presentations on papers. Discuss reasons for becoming a teacher; what do you need to know and where can you learn it; distribute final exam questions, course evaluation.

FINAL EXAM: **Tuesday, December 6, 3:00-5:00 p.m.**

FIELD ASSIGNMENT #1

TIME AND SPACE AS CLASSROOM RESOURCES

This first field assignment will help you get acquainted with Deborah's classroom and also help you explore several often taken-for-granted but critical classroom resources time and space. In addition, this assignment will help you focus on what Deborah is trying to accomplish and how she does this.

Space

In-class task: Draw a map of Deborah's classroom. You map should include the following: (1) arrangement of students' desks; (2) teacher's desk (if she has one); (3) wall or bulletin board displays (do these include student work, teacher-made materials, or commercial materials?); (4) special areas in the room and what they appear to be used for; (5) location and description of supplies and instructional materials (are these accessible to the students?); (6) storage area for students (if available); (7) other significant features of the classroom. During class, observe how the space is used so that you can answer the questions below.

Outside of class: (1) Do students move from one area to another? If so, who decides? (2) What kind of interactions among students and between the students and Deborah are possible given the room arrangements? Which kinds actually occurred as you observed? (3) What do the displays on walls and bulletin boards convey to students? Why do you think this?

Time

In-class task: Keep a log of how time is used in the classroom. (Consider the questions below in deciding what to note down in your log.) Use your log to analyze the use and meaning of time in the classroom by answering the following questions carefully and thoughtfully.

1. Calculate the percentage of time devoted to "academic" work, "non-academic" work, and "down time." Draw a pie diagram to illustrate. (Note that I am deliberately not defining what each of these means. I want you to decide what you would include in each and why.)

2. Of the "academic" work, what percentage involves teacher instruction to the whole group? What percentage involves individual work time? What percentage involved small group instruction?

3. What definition of "academic" is implied in your classification system?

4. From the allocation of time, what can you infer about Deborah's priorities? (Answer this question in terms of your answers to questions 1, 2, and 4.)

Relationships between teacher, students, and knowledge

In-class task: Note the ideas, problems, procedures, or concepts that Deborah appears to be teaching. Keep a record of the statements Deborah makes and the questions she asks (verbatim, if possible), the responses students give, and what Deborah does with the students' responses. Also, note students reactions as the class goes on--who appears to be paying attention and who isn't paying attention, who participates in discussions and who doesn't, who gets called on and who doesn't.

Read over the questions below as a guide to the fieldnotes you should take.

Out-of-class activity: Answer the questions below.

1. Which of the students was tuned in and which were not? How do you know?
2. When Deborah asks a questions, do you think she has an answer already in mind? How do you know?
3. What did Deborah want her students to learn during this lesson? How do you know?
4. What were Deborah's purposes in teaching this lesson (this may be philosophically broader than your response to Q. 3)? How do you know?
5. Did you learn anything about math from the lesson? If so, what?

FIELD ASSIGNMENT #2

MANAGING THE LEARNING OF DIVERSE STUDENTS IN CLASSROOMS

__Purpose__: The focus this week is to try to uncover and understand how Deborah handles the differences among the learners in her classroom.

__In-class task__: During class pay particular attention and take notes so that you can answer the questions below later. Be sure to note changes in how students are grouped whenever an activity changes and/or every five minutes. If the way students are grouped doesn't change, you needn't repeat your answers.

__Outside-of-class assignment__: Answer the following questions in writing:

1. Are all students doing the same activity or assignment? If yes, go to question 4.

   If __not__, is each student doing something different, or are the students' activities or assignments grouped in some way?

2. Describe the different activities or assignments. What is different about them: content? difficulty? format? something else? Write down a couple of examples of how the assignments are different.

3. How does Deborah spend and allocate her time among the groups or individuals who are doing different assignments?

4. How are students reacting to their activity or assignment?

__Analysis__: Fill in the following chart. __Draw on the readings__: Featherstone's and Oakes' two articles, as well as Jackson (hidden curriculum, crowds), and Lampert (dilemmas) to help strengthen your analysis.

Brief description of what students were doing and how they were grouped:

Three advantages of this arrangement:	For whom is it an advantage?
1.	
2.	
3.	

Three possible disadvantages of this arrangement:	For whom is it a disadvantage?
1.	
2.	
3.	

FIELD ASSIGNMENT 3

OBSERVATION OF TEACHING AND LEARNING

Purpose: The purpose of this field assignment is to focus you closely on a case of teaching and learning in your field classroom--to understand what the teacher is trying to do, what happens, and what students make of it.

Task: This assignment consists of 2 parts: (1) a group interview of Deborah and (2) an individual interview of a student in Deborah's math class.

Teacher Interview: The purpose of this interview is to understand what Deborah thinks she is teaching and why. Questions that you will want answers to are:

- o What do you want the students to get from the lessons that you have taught the past two weeks?
- o How likely is that students have learned what you want them to learn (for some students, for all the students)? How do you know?

Student Interview: We will develop the clinical interview that we conduct with students in class. Part of the purpose is to find out what they understood and why they thought they were learning this. We will have to design the questions to fit the age of the students and the what they are learning.

Write up to turn in:

This should be brief (i.e., approximately 2 pages) and very specific. Back up what you say with examples from your data. Bring all your notes to class on Monday.

a. A brief summary of the Deborah's goals and what you have seen happen in her classroom over the past three weeks.

b. What about the lesson do you think was the most difficult thing for your teacher?

c. For the students you interviewed:

1. What did they understand? How did you determine this?
2. Why did they think they were learning this?

d. Your commentary on the relationship between (a) and (b).

FIELD ASSIGNMENT #4

WHAT DO TEACHERS KNOW?

__Purpose__: On this last day in the field, you will be trying to get to think about what Deborah knows that enables her to teach as she does. Up to now, our focus has been on her actually teaching and the tasks that the children do. Now, I want you to think about what lies behind Deborah's actions.

__Task__: We have watched Deborah work with her students on positive and negative integers. She has organized specific learning activities to help them learn about this. Your task will be to ask her questions to figure out what she knows that allows her to teach as she does. A number of you have pointed out that her purpose is to have students figure out for themselves what positive and negative numbers are and why certain procedures with integers occur as they do (for example, addition and subtraction). Some of you have noted the social and intellectual sophistication of the discussions that her students have in class. Your task is:

1. Figure out questions to ask Deborah that will help you figure out what she knows that enables her to teach as she does.

2. Observe her closely during her class. Pay close attention to what she says and does. How does she know what to do next?

__Analysis and write up__

*****Give concrete examples to back up your assertions.*****

Based on all of your observations of Deborah and the questions you have asked her, write a brief (2-3 page) analysis of what you think she knows. At the end of your paper, describe what else you think __you__ would need to know if you chose to teach math as Deborah does.

Appendix B

CLINICAL INTERVIEW

Exploring Teaching

CLINICAL INTERVIEW

Nov. 10, 1988

The questions in bold print below are what you should actually ask your student. The other text are directions for asking the question. Do not try to write students' responses on this form. Write their answers in your notebook.

1. **If I tell you 8 + 4, can you make up a story that goes with that?**

   [If the child doesn't understand what you mean, talk through an example together--e.g., **"I had 8 Hershey bars and my mom gave me 4 lollipops. How many pieces of candy did I have then?"** Then ask: **"And how much candy do you have then?"**]

   [Repeat this question for the following:]

   7 + 36 - 39 + 5
   85 - 535 - 8

   [For each computation ask the child to tell you the answer <u>and</u> to interpret what the answer means.]

2. **I notice that you have been working a lot with negative numbers. Can you explain to me what the answer to 6 - (-4) is?**

   [If student just explains the procedure but not what the answer means, ask:] **I don't quite get it. Can you explain that to me? How did you get ___ ?**

3. [For this question, you will need to make up a card--you can use index card--with the numbers below listed clearly it.]
   [Show the card to the student and say:] **Here are some numbers. Could you write these down, arranging them from the smallest number to the largest?**

   167
   5
   42
   -3
   -254
   -10
   8

4. [Give the child two minicomputer boards. Ask:] **Make all the numbers you can using one negative and one positive checker on these boards.**

   [Write the numbers down that the student discovers to help him/her keep track.]

   [Keep probing for the reasons why the students thinks their solutions make sense.]

   [Try to learn how and when the child decides that he/she is finished, that is, has found all the possible numbers.]

5. **Before Mrs. Ball's class, had you ever learned about positive and negative numbers before?** [If yes:] **Where was that? What did you learn?**

6. How do you feel about having to give a reason every time you tell the class your answer to a problem in math class?

7. Does anyone help you with your homework in math? What do they do to help you? Has anyone helped you with positive and negative numbers besides Mrs. Ball?

8. How do you feel about working with a partner on math? How about working with other classmates in groups on math?

9. How do you feel when someone challenges your answer in math class?

10. On the back wall of your classroom are some signs on which are written hypotheses about math that some of the kids in your class have thought of. There are also signs with math theorems on them that the class has thought of. What does the word hypothesis mean to you? What does the word theorem mean to you?

Appendix C

PAPER ASSIGNMENT #1

Paper #1
Exploring Teaching

CASE OF TEACHING AND LEARNING

Purpose: The purpose of this paper is to help you focus on the interaction between teacher, learner, and subject matter, by reflecting on and appraising your experiences with positive and negative integers and your observations of students in Deborah Ball's classroom.

Assignment: Put together a personal case study of teaching and learning about positive and negative integers, drawing from your notes, reflections, and the readings (particularly, Hawkins, Paley, Kohl) and our discussions. You should approach the teaching and learning of positive and negative integers from the following perspectives:

1. As an observer in Deborah's classroom. How did Deborah go about helping her students understand positive and negative integers and operations with integers? What were her goals? How well did she achieve them? How do you know?

   How did her hidden curriculum--the way she and her students coped with crowds, praise (evaluation), and power and her use of time, classroom space, and grouping arrangements--advance or not achieving her goals?

   How did the students react to her teaching of integers? Why do you think they reacted this way? What do you think the students learned? How do you know? What do you think the students think about mathematics based on their experience in Deborah's class? What do you think of themselves as learners of mathematics and in general? How well are they prepared to learn more mathematics?

   Suggestion: You may want to refer back to Jackson's discussion of the hidden curriculum in the chapter in your packet entitled "The Daily Grind"; in thinking about her use of grouping, Jeannie Oakes's articles and Helen Featherstone's piece in the Harvard Education Letter may be useful; you may also want to look again at what Kohl says about teaching content and at the "I, Thou, It" relationship between student, teacher, and subject matter to help you in thinking about how Deborah relates to the subject matter and the role it plays in her relationships with her students.)

2. Describe your experience as a learner while you learned about integers and operations with negative and positive integers. What were you learning about mathematics? About learning mathematics? About teaching the subject? What things did you do, say, hear, or see that helped you learn these things? What things interfered with your learning or confused you? What seemed to make little difference? Who helped you learn and in what ways? How did you feel about your learning and why? How did this experience connect or compare with your previous experiences as a learner in mathematics?

3. Document your experience as a teacher of operations with positive and negative numbers? With whom did you work and what did you do with that person? Describe in detail what happened (what each of you did and said). Provide your best interpretation of what your learner did that will shed light on that person's thinking (give evidence for your speculations about this). Explain what you did and why you did or said what you did at the points you did. What were you trying to do? What role did your understanding of integers play in any part of your teaching or thinking about teaching?

   Did your experience as a learner influence what you did as a teacher? How so? Did your experience as a teacher influence your own learning? In what ways?

4. What conclusions about teaching, learning, and subject matter do you draw from this project? Why? What do you think it implies for you in learning to teach?

Working with a buddy: After writing a first draft, exchange your draft with a buddy. You are to respond to your buddy's draft in writing. Your response should comment on (1) the central points made in the paper, (2) the examples used to illustrate and support these ideas, (3) ways to strengthen organization (most of us need help especially with the introduction and the concluding synthesis, and with figuring out the order of ideas, (4) the writer's interpretation of the readings.

After you receive your buddy's response, you should meet with your buddy to receive his/her comments. You should then revise your paper and turn it in to your instructor.

Turn in your messy first draft and your buddy's written comments along with the final version of your paper. Make sure your name is on the sheet of comments you give your buddy. Part of your grade will be determined by the thoughtfulness of your comments.

Grading: Your case study will be evaluated on: (1) your use of specific details and examples from the project activities and readings to support your main points; (2) reflectiveness, that is, how much thought have you put into what you are writing as opposed to repeating what certain authors has said or just writing down the first thought that stumbles across your mind; (3) your use of standard spelling, grammar, and syntax; (4) and the organization, logical flow and cogency of your paper. This last criterion means that your paper should be an integrated whole, not a collection of loosely related paragraphs.

Appendix D

FINAL EXAMINATION

FINAL EXAM

Exploring Teaching
Nov. 28, 1988

General Directions: In answering the questions below, keep in mind any remarks about the difference between papers that set out to tell me what you know about a subject and papers that try to make an argument. By making a persuasive argument, you will be telling me what you know. A good argument is distinguished by its use of evidence (from your observations or from the readings), its focus (it doesn't stray from the main point it's making), and it's logical flow and coherence (it makes sense to the reader). So figure out what you think about each of the questions below and then persuade me that your point of view is the best, given the available evidence.

I. (8 points) You've spent several hours this term observing Deborah Ball's class and interviewing her and her students. You have also now viewed a videotape of Bob teaching his fourth graders operations with positive and negative numbers. Drawing on your extensive fieldnotes from Deborah's class, on your notes on Bob's class, and on course readings address the following questions:

1. Compare the goals Bob seems to have (based on your observations) with those that Deborah has. Use specific examples from your observations to support your view of their goals.

2. How does the hidden curriculum in Deborah's classroom compare with that in Bob's classroom? What does the hidden curriculum in each convey to students about:

   a. Their relationship to other students?
   b. Their capacity to learn mathematics?
   c. Their relationship to the teacher?
   d. The role of the teacher?

3. Compare the opportunities that students in the two classrooms have to learn:

   a. about operations with negative and positive number
   b. about what mathematics is and why they are learning it
   c. about themselves as "doers" of mathematics

4. How does Bob represent the subtraction of negative numbers? What do you think of these representations? How do they compare to representations you saw/heard in Deborah's classroom? What are the relative advantages and disadvantages of each? What have you learned about what makes a useful representation?

5. While you know far less about Bob than about Deborah, speculate on the source of similarities and differences in the ways they approach the teaching of operations with integers. Why do you think they approach the topic as they do?

Readings: In addressing the questions above, the following readings may prove helpful:

Philip Jackson in his chapter "The Daily Grind" describes the role that the hidden curriculum plays and focuses on 3 features of the h.c.: crowds, praise, and power. Deborah and Bob deal with each of these features differently, thereby communicating very different messages to their students about the students themselves, their classmates, about mathematics, and about the role of the teacher.

Hawkins and Kohl discuss the role of subject matter in the relationship between teacher and student. They discuss the importance of subject matter as something outside of the teacher-student relationship that is a common subject of interest. Vivian Paley portrays instances in her teaching when students are working on understanding subject matter. What is less clear is how the teacher so arranges things so that the subject matter is a genuine common interest. While people talk about "making it interesting" to children, some would question how far you can go before you "water down" a topic or idea so much that you to distort it. How do Bob and Deborah deal with this?

II. (6 Points) CHOOSE ONE OF THE SCENARIOS BELOW AND ANSWER THE QUESTIONS THAT FOLLOW IT.

Scenario A

Imagine that you have been elected spokesperson by a delegation of teachers at the school in which you teach who oppose the policy of ability grouping in reading. On behalf of the group, you are to write a brief position paper laying out the arguments against ability grouping for the school board. In the previous day's newspaper, the president of the school board, in an interview, has stated:

> I don't see why the teachers want to do this. Everyone knows that some kids are just naturally better readers than other kids. Why should good readers be held back because of the few who aren't getting it? We've been putting kids into groups based on their reading ability for years--I just don't see any reason to change now.

Your briefing paper should answer the school board president's assertions and make an argument for why you think grouping by ability is a bad idea.

Scenario B

Imagine that you have been elected spokesperson by a delegation of teachers at the school in which you teach who oppose the policy of homogenous grouping in reading. On behalf of the group, you are to write a brief position paper laying out the arguments for ability grouping for the school board. In the previous day's newspaper, the president of the school board, in an interview, has stated:

> I don't see why the teachers want to do this. Recent research has demonstrated the detrimental effects of ability grouping on the students who most need help in reading. Why should readers who have difficulties be denied equal opportunities to learn just because they are having difficulties? We've been putting kids into groups based on their reading ability for years--and as a result a large number of students never learn to read with adequate comprehension.

Your briefing paper should answer the school board president's assertions and make an argument for why you think grouping by ability is a good idea.

III. (6 points) Reacting to my responding to a question with another question ("What do they rest of you [referring to our TE101 class] think about that?"), Bryan Harrison remarked after Deborah's class one day: "I could do your job!"

Bryan's point is an interesting one to consider. A number of you this term have become frustrated when, in response to questions you've asked or a statement you've made, I have asked another question rather than answering your question or confirming/disconfirming your statement. Several of you pointed out that Deborah tends to do the same thing in her classroom: When students offer a solution to a problem, she accepts it whether it is right or wrong and then asks other students what they think of the suggested solution.

I want you to evaluate Bryan's remark. Could he do my job? Could he do Deborah's job? What does anyone need to know or be able to do or be inclined to do to do what Deborah and I do? Is it in fact the case that common sense is all you need in order to teach? What is left out of common sense? [See Chapter 1 in Jackson's The Practice of Teaching for a discussion of common sense in teaching.] What about just learning some techniques like how to ask good questions? Do Deborah and I know anything beyond some techniques? If so, what?

If you don't think Bryan could do my or Deborah's job, what else do you think he needs to know? Where do you think he will learn this? (Just saying he will learn this "from experience" is not sufficient. Such a statement begs the question: What do we learn from experience and how? If teaching is something we learn from experience, why are there teachers with 10-15 years of experience in whose classrooms many students learn little that is in the official curriculum? Many people in this class reported in their first papers that their teachers taught them only the rules in math. Why didn't these teachers learn from experience that this limits children's capacity to learn about mathematics later on?)