DOCUMENT RESUME

ED 422 299 SP 038 089

AUTHOR Myers, Charles B.; Jones, David; Snyder, Chris
TITLE A Teacher Educator Studies His Teaching: A Self-Study with Multiple Perspectives.
PUB DATE 1998-04-14
NOTE 17p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Diego, CA, April 13-17, 1998).
PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Action Research; *Computer Uses in Education; Constructivism (Learning); Educational Change; *Educational Technology; Higher Education; Introductory Courses; Preservice Teacher Education; Reflective Teaching; *Self Evaluation (Individuals); *Teacher Educators; Teacher Researchers
IDENTIFIERS Reflective Thinking

ABSTRACT

This paper reports on a 2-year study of changes that occurred in one instructor's teaching of an introductory undergraduate course on teacher education across four semesters. The study includes the voice of the instructor and four other participant-investigators. The course underwent three important modifications: (1) adding a technology emphasis, (2) moving to a combination of information-input and a constructivist and inquiry-based orientation, and (3) moving classes to multi-media, high-tech settings. The study examined: how emphasizing technology changed the instructor and the students; how the shift toward a constructivist, inquiry-oriented approach affected student learning and attitudes; how change in class location affected the instructor's teaching and class dynamics; what support and resource issues arose due to the increased technology emphasis; how each course modification affected class discussions, student interaction, and student performance; and what unexpected changes occurred as by-products of the three modifications and the self-study. Data came from class observations and videotapes, analysis of class videotapes, personal reflections by the investigators, interviews with the instructor, discussions with the investigators, copies of student work, and student surveys. Results indicated that considerable technology was added, and it was a positive move. Subtle changes in the instructor's teaching resulted from the shift to a more constructivist, inquiry-based orientation. Changes in location allowed for more flexibility in teaching and more interaction with students. (SM)

A Teacher Educator Studies His Teaching: A Self-Study with Multiple Perspectives

American Educational Research Association

by
Charles B. Myers
David Jones
Chris Snyder
Peabody College, Vanderbilt University
Nashville, Tennessee

April 14, 1998
San Diego, California

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Introduction

This paper reports on a two-year study of changes that have occurred in one instructor's teaching of the introductory undergraduate course on teacher education across the four semesters of 1996-1997 and 1997-1998. Although the instructor, Charles B. Myers, has taught the course for more than a decade and had written the text that provides the primary content for the course, the course has undergone three significant modifications during the years of the study. Those modifications prompted us to undertake the self-study in an effort

(1) to develop clearer perceptions of how the course is being taught and
(2) to assess how the instructor has responded to the modifications that have been taking place.

The three modifications have been as follows:

(1) the course was made "technologically intensive" as part of a college-wide, funded project to add technology-based instruction and technology-involving student assignments to all introductory courses for freshmen;
(2) the thrust of the instruction for the course was shifted from primarily information-input to a combination of information-input and a "constructivist" and inquiry-based orientation; and
(3) the classes were moved from a traditional classroom setting to multi-media, high-tech settings -- to an auditorium with flexible seating options for three semesters and then to a regular size room for the current semester.

Although the study at its core has been the instructor's personal self-study, it has involved a team of five participant-investigators and, therefore, a set of five interacting perspectives or "voices." The instructor and two of the other four participant-investigators are co-authors of this paper. The five are

(1) Charles B. Myers, the instructor for the course;
(2) David Jones, a third-year doctoral student majoring in Curriculum and Instructional Leadership with an emphasis in Teacher Education, who has served as a teaching assistant for the course in both 1994-95 and 1996-98 (the two years of the study);
(3) Chris Snyder, a third-year doctoral student in Educational Technology, who served as a "technology assistant" for the course during 1996-1997;
(4) an undergraduate student enrolled in the course during the spring of 1997; and
(5) a third-year doctoral student assigned by the college-wide project to monitor, assess, and document the impact of the technology initiatives during 1996-1997.

Focuses of the study have been

(1) changes in the instructor's teaching style, strategies, and techniques as a result of the three course modifications;
(2) changes in his interactions and relationships with students;
(3) evidence that he and the students have been engaging in "constructivist," inquiry-oriented teaching and learning;
(4) evidence that the cognitive level of student learning has been rising; and

(5) indications of unanticipated changes in the instructor's teaching and student learning that do not seem to tie directly to the three course modifications.

This paper describes

(1) the study design and operation;
(2) the roles, perspectives, and focuses of each participant-investigator;
(3) observations, inferences, reflections, "voices," and conclusions of the three author-participant-investigators, with some references to those of the other two non-author-participant-investigators;
(4) summary conclusions drawn by the three author-participant-investigators; and
(5) suggestions of how the study and its results can be useful to other teacher educators -- particularly those interested in self-study.

Objectives and Purposes

The study was undertaken to address the following specific questions:

(1) In what ways did the *adding of a technology emphasis* to the course change the instructor's teaching, the students' learning, and the instructor's and students' attitudes toward the course?
(2) In what ways did the *shift toward a constructivist, inquiry-oriented approach to teaching and learning* affect student learning, student attitudes toward the course, and student ideas about teaching at the pre-K-12 levels?
(3) In what ways did the change in class location and setting affect the instructor's teaching and class dynamics?
(4) What support and resource issues arose because of the increased technology emphasis and how were they handled?
(5) In what ways did each of the course modifications affect the intellectual level of class discussions, student interaction (in class and electronically), student performance on assignments, and student academic performance in general?
(6) What seemingly unrelated and unexpected changes occurred as by-products of the three course modifications and of the self-study?

Perspective and Theoretical Framework

This study began because the instructor was asked to participate in a project to infuse technology into his beginning undergraduate course on teacher education and to assess the impacts of doing so, but he, as the course instructor, added two additional purposes to the experiment:

(1) to shift his instruction from a primarily information-input emphasis to a combination of both information-input and student inquiry in a "constructivist" way and
(2) to use the experimental setting to engage in a thorough self-study of his own teaching.

In essence, the instructor had thought about self-study of his own teaching for some time and this project gave him the opportunity and motivation to apply serious self-study to his teaching and thinking. It also provided opportunities for the four other participant-investigators to participate.

Mode of Inquiry and Data Sources

The study can be explained best by describing the activities that have been involved. The course that has been studied is the first course, a required course, for all undergraduate students in teacher education at Vanderbilt University -- during 1996-1997 it involved 127 students in three separate class sections in the fall and 27 students in one section in the spring, for 1997-1998 the numbers were 101 and 30 respectively. In the spring of 1996, the instructor agreed to be a part of a college-wide endeavor to make all initial undergraduate courses in Peabody College of Vanderbilt University "technologically intensive" in at least two ways -- in instructor use of technology and in the requirement that students learn to use technology at a significant level in their study. He took the opportunity of the experiment to also change his primary approach to teaching the course and to engage in serious self-study of his work (as mentioned above). The four other individuals associated with the course (also mentioned above) were engaged as co-investigators, assessors, and monitors of the project's activities and their apparent impact.

Data sources have been the following:

(1) class observations and videotapes of all class sessions of one of the three fall sections during 1996 and 1997 and of the one spring section during 1997:
(2) independent analyses of the class videos by the author-participant-investigators (including the instructor) each from a different perspective and with a different focus (which are explained below);
(3) personal reflections of each of the three author-participant-investigators;
(4) audio-taped, structured interviews of the instructor ;
(5) audio-taped structured discussions that included all five of the participant-investigators;
(6) copies of student work (including electronically produced work); and
(7) anonymous questionnaires completed by all students in the course for both semesters during 1996-1997 and the fall semester 1997.

Observations, Inferences, and Reflections

The Instructor's Perspective

My perspectives on a few of the changes that have occurred in my teaching of the introductory teacher education course over the past two years are reported below.They are reported in succession in terms of the three course modifications that took place: the introduction of more technology, the shift to a more "constructivist" or inquiry orientation, and the changes in classroom location. In presenting these perspectives,

(1) I describe what I believe happened in several dimensions of the course over the two years;
(2) I infer my personal reasons for why these things happened and what else occurred because they happened; and
(3) I reflect about both what happened and my inferences.

The perceptions are framed by the five focuses of the self study (as itemized above) and are guided to some extent by the six questions that served as the study's objectives (also listed above). However, because of space limitations and the fact that the study has produced so much information, I have concentrated here on the first study focus: changes in my teaching style, strategies, and techniques. Although I do touch slightly on changes in my interaction and

relationship with students and the extent to which students engage in "constructivist" inquiry, I do not cover each study focus thoroughly and I do not address each specific guiding question in detail.

As I begin this section of the paper, I believe that it is important that I make note of two points. First, my first and foremost role in this endeavor have been as the instructor of the course rather than as an investigator. My first set of priorities has to do with teaching; studying that teaching, although important, has been secondary. Second, much of what I present here is description rather that interpretation. As I wrote the paper, I realized that the description is necessary for reader understanding.

Changes resulting from the new uses of technology

As would be expected, the most obvious changes in my teaching have been tied directly to the conscious introduction to the course of specific uses of technology that I had not used previously in either this course or my teaching in general. These new uses of technology include the following:

(1) the establishing of a class web page,
(2) the taking of individual pictures of all the students and projecting the pictures and student names for all to see before the start of each class during the first weeks of the course,
(3) individual student e-mail "paper" assignments,
(4) a particular form of a class list-serv,
(5) a sequence of electronic group discussions,
(6) power point visual presentations,
(7) the placing of slides and graphics for each class on the web page, and
(8) professor-student and graduate assistant-student e-mail communication.

Each of these is elaborated upon below.

The class web page has served several functions. First, it provides a means and a push for me to organize the course well in advance of each semester and, as a result, has led to a tighter course organization and more consistency in course content and activities from semester to semester. Second, it enables me to introduce the course, via the web, during the summer to students who register to take it in the fall semester. This is particularly unique (at least for me) because I send a welcoming letter in July to all registrants, in which I ask them to "check out" the web page. This serves as a new type of initial contact with the students and seems to be particularly significant for entering freshmen, who constitute about 75 percent of the fall course enrollment. Third, that early web-page contact with students introduces me to them in a non-classroom context, which includes connections to my and the teaching assistants' personal web pages, which in turn provide both broader professional and personal information about us. For example, students learn that I and my wife wrote the text for the course, that my wife teaches third grade, that we vacation regularly at the beach, and that I snorkel. (Pictures are included.) Fourth, the web page provides a readily available source of reminders of class assignments and of all slides and graphics that have been presented in classes to date. (The web page address for the current semester is http://peabody.vanderbilt.edu/courses/Spring_98/educ1020/).

I believe that the web page emphasizes the serious nature of the course and provides an early counter to the assumption by most new students that, because the course is an education course, it will be easier and less substantive than their other courses. It also communicates clearly that computer literacy is expected in the course and at Vanderbilt in general. The web page also provides what I think is a different-than-expected image of me as the course instructor. This is

important to me because I hope that my students see two sides of me as their teacher -- a normal, friendly, caring, "readily-available" adult on whom they can rely for guidance and support; and a serious, demanding instructor and evaluator of their performance. The web page seems to be especially useful in presenting the "friendly, caring" side of the image, which is hard for me to convey in a classroom setting that stresses serious academics.

Because students can turn to the web page as a source of class reminders and previously presented content, I feel free to avoid tediously repeating information in class as students copy data from class slide projections. I and the students know they can return to the information on the web, so I can maintain a crisp pace and students can think about ideas that are presented, not just record them in their notes.

In reference to this last point, I should point out two things: (1) the web data are class graphics and general ideas covered in lectures or discussions, not my class notes; and (2) the data appear on the web only after I teach the class. These two points, I believe, are important because to post my class notes or to post information or ideas before they are taught would run counter to the "constructivist," inquiry thrust of my instruction.

Scrolling student pictures and names one-by-one at the start of each class for several weeks helps all students to get to know each other better and more quickly, and, I think, this promotes class and e-mail student-to-student discussion. It appears to help make the classes of 35-45 students seem smaller. I also keep a full set of the pictures (with names) on my own desktop, which I study to put names and faces together quickly and keep for reference beyond the end of each semester.

All the individual student e-mail "paper" assignments ask for student reflection and analysis of their own thinking. For instance, one that is assigned during the first class and is due before the second class asks students to inquire into what caused them to think of teaching as a career and to infer why this occurred. A second asks them to place themselves in the role of a character in a video shown in class and to describe what they would have done in the situation and why they think they would have done so. Each assignment is due by 8:00 a.m. on the morning a class session is scheduled, so I and the teaching assistants can scan and record the responses before class. We can then discuss either submission difficulties or substantive matters concerning the assignment in class.

The e-mail "paper" assignments have accomplished a number of objectives. They require students to use e-mail technology, they allow me to scan student ideas before a class as opposed to collecting papers in class and reading them later. The greatest value of the assignments, however, is a phenomenon that I believe is directly tied to the e-mail as a medium: that is the depth of reflection and analysis that most students express in the "papers." The papers frequently involve self-analysis, the probing of personal values, and the relating of deep and powerful personal experiences. Most are impressively meaningful and many include sincere emotion. Some are inspiring and moving for me. I rarely had this type of depth in virtually the same assignments over many semesters when the assignments were submitted in paper, hard copy form.

The class list-serv is used primarily for group electronic discussions, something not possible with paper and pencil exchanges. Students respond individually to an assigned topic, case or dilemma, and then respond to and critique each others' ideas and reasoning. The on-line discussions are coupled with in-class, face-to-face discussions.

The electronic discussions have been valuable in several ways. Students can be expected to probe and defend their own and each others' thinking, not just react to the substance of the topic or

case under review, and they do this to a surprising degree. Exchanges can be made and responded to quickly, and they are. Most surprising, however, is the pointedness and depth of the discussions that take place. Students challenge each others' thinking, reasoning, and value bases. The intellectual level of the exchange is great.

Using power point visual slides makes the class presentations appear to be more polished and sophisticated when compared with my class projections of the past, and it allows for easy student retrieval of the information that is presented in class by their use of the web page (as noted above). But, in my judgment, there is a down side to this electronic tool. Presentations are less flexible and more dependent on the reliability of the equipment. Last minute changes are rarely possible, shifts of content in response to student questions or lack of understanding are more difficult, and, if something breaks or is not focused, quick adjustments are often not possible.

Some of these difficulties involve simple mechanics of operation and will be overcome with more and better equipment and improving skill, but some, I think, are inherent in the nature of the medium. For example, slides must be prepared and organized before class and changes require interruptions to the instructional flow. (Shuffling overhead transparencies was quicker.) When a slide presentation is used, writing on the white board is nearly impossible to see; and when a color projector lamp fades, an out-of-town repair person must be called. These conditions cause me to feel less in control of a class and they interfere with my managing of the flow of ideas and student interaction. At times, they cause me to be less willing to try particular types of rapid-paced activities for fear of mechanical difficulties.

E-mail communication, between my students and me has led to an increased number of contacts and to changes in the type of contact in bi-polar ways. On one hand, students frequently contact me "just to say hi," to be reassured about an assignment even though it is printed in their syllabus, to explain or forewarn me about a class absence, to see if I am in my office and free to meet with them "if they walk over," and to ask advice for a teacher-parent or friend who has a specific classroom problem. On the other hand, they use e-mail to "talk to" me about deep personal problems. The contact is frequent and time consuming, but it is often very meaningful and rewarding for me. It draws me closer to students who use this means of communication. In short, it is, at the same time, an intrusive and personally fulfilling development for me as a teacher.

Changes resulting from the shift to a combination of inquiry along with information-input

In contrast to changes that are direct results of my use of technology, changes in my teaching that, I believe, have resulted from my effort to shift to a more "constructivist" and inquiry-based teaching orientation are subtle, even though they are readily apparent and similar to those mentioned above. The subtlety can be attributed to at least two points:

(1) the fact that my specific uses of technology and the inquiry-orientation of class activities and assignments are intermixed, thus making it hard to determine if the changes are technology or inquiry driven; and
(2) the shift toward inquiry is a matter of degree, not a change in kind -- that is, I have not shifted completely away from information input and in the past I did include some amount of inquiry in my instruction.

Although David Jones's perspectives, which are described below, focus more directly on this aspect of the study, I offer here a few of my perspectives. As background I should explain that I intentionally want the course to be a combination of both information-input and inquiry, not all inquiry. I believe that introductory students need to learn new information that they cannot

efficiently discover on their own and I believe they expect to be presented with that basic information by their instructor. I also believe that they need a substantial amount of expert explanation of that information.

On the other hand, the uses of technology and the fact that I selected the content for the text both allow me to engage students in thinking, analyzing, and reflecting activities in class, in assignments, and on-line. The electronic vehicles permit student-to-student discussion outside of class time and they (the electronic vehicles) allow me to see those discussions "in print." They also enable me to use appropriate amounts of class time to structure and follow-up student activities.

As I have studied my classes over these two years, I have been comfortable with the information-input versus inquiry mix, although other observers might classify more of my teaching as exposition and information-input than "constructivist" in orientation. In fact, David Jones, the teaching assistant, and the college-wide project monitor member of our project team hold this view and believe I should be more inquiry oriented than I am. Most of the students in the classes, on the other hand, say they would like me to do more lecturing, particularly on content in the text that is covered on the tests.

In my view, the shift to more inquiry has meant that I ask students to probe more intellectually, to react to class cases and other students' ideas more frequently, and to reflect upon their own beliefs more deeply. However, I have structured the class so that much of that inquiry occurs in assignments rather than in class, I do not want to cut back on other class activities in order to provide the time. My talk-time in class is a combination of exposition and the structuring of activities that require student thought and analysis. About one-third of the class time consists of video presentations that are intended to prompt student self-reflection and personal value analysis. Four class sessions are structured visits to schools and classrooms, and all of these are followed by reflective reporting and discussion. A final course assignment is a reflective paper in which students trace the evolution of their own thinking about schools and teaching. It is significant, however, that most of the students' reflection occurs in their completing of out-of-class and on-line assignments rather than during in-class discussion.

Changes resulting from the change in classrooms

In my view, although the changes in the classroom location of the course enabled me to be more flexible in my teaching and more interactive with the students, the driving forces for modifications in my teaching were not the changes in classroom settings but the uses of the new technology and the shift toward more inquiry. The new classrooms simply enabled these other pushes toward change to occur more smoothly. However, I should say that the poor acoustics and sometimes unreliable electronic equipment of the large auditorium, which I used for three semesters, did have inhibiting effects. I avoided some teaching techniques and some amount of student interaction because of these problems. Most of those inhibitions have been ameliorated by moving to the classroom location where I am now teaching.

The Teaching Assistant's Perspective

For this study, I have utilized my perspective as a teaching assistant for the course for three years. My first year as the teaching assistant, 1994-1995, was prior to the three course modifications, already mentioned, that prompted this study. The other two years of service were from fall 1996 to spring 1998, the two years comprising the self-study.

Given the instructor's genuine interest in shifting his teaching from primarily information-input to constructivist and inquiry-oriented, I have chosen to observe and analyze the teaching and

learning in the course according to principles of constructivism. Because of space limitations, I will not provide a full review of the literature I consulted in my search for principles of constructivist teaching here. Instead, I offer my abstraction of what I see as three core characteristics of constructivist teaching. These characteristics are not offered as all-encompassing, rather as just a few core ideas that have been useful in my ongoing analysis of the teaching of the course. Also, it should be noted that constructivist theory does not, in itself, explicate specific teaching practices. That is, as a theory of learning and knowing, constructivism has more to say about learning and less to say about teaching. Any effort to make one's teaching more resonant with constructivist theory (or, in this case, to evaluate another's teaching in light of constructivist theory) must, therefore, use the theory as a referent for pedagogical decisions (Tobin & Tippins, 1993).

Based upon my review of the literature, and my need for a few useful principles, I have framed my observations and analyses of the professor's teaching according to the following key characteristics of constructivist teaching:

(1) The teacher gives invitation and provides opportunities for students to uncover and analyze their own prior knowledge, beliefs, assumptions, and attitudes.
(2) The teacher gives invitation and provides opportunities for students to confront the knowledge, beliefs, assumptions, and attitudes of others; and
(3) The teacher gives invitation and provides opportunities for students to reflect on all of these.

What follows are six somewhat-interrelated points. The first two points cover what I have witnessed to be changes in the professor's teaching of the course related to his interest in shifting from an information-input (i.e., lecture) model to a constructivist model. The last four points contain my thinking as a result of reflecting on: (a) these changes, (b) their relationship to what I have described as my conception of constructivist teaching, and (c) the interrelationships of my findings and reflections and the nature of this particular inquiry.

Changes I Observed

The first finding I report is that, based upon both my observations and inquiries during the two years of this self-study and my observations and recollections as a teaching assistant for the course during the 1994-1995 school year (which was prior to the three course modifications already noted), there is evidence that new and increased opportunities for students to reflect and engage in dialogue with other students have been created. Most of these "new" opportunities have become possible as a result of the infusion of electronic communication technologies (i.e., e-mail and list-serves). Of particular interest, given my focus on constructivist teaching and learning, are the two list-serv assignments. Both assignments engage the students in the examination and articulation of their prior knowledge, values, and beliefs. They also both involve forcing the students to make their thinking public, and thus open to scrutiny. In one of these list-serv activities, the students must also voice disagreement, via e-mail, with another student. Based upon my own reading of these responses over the past few semesters, I see a level of thinking and reflecting that seems to go beyond much of what I witnessed over the two semesters of the 1994-1995 school year. That is, there is an obvious focus on individuals' prior experiences, knowledge, values, and beliefs that was not as explicit in my early semesters of working with this course.

While I have personally enjoyed reading the students' responses to these assignments and have witnessed what appears in some cases to be a deeper level of reflection, the question still remains as to the result of the experience on students' thinking, reflecting, and altering of beliefs.

In an attempt to ascertain some of this, I distributed a questionnaire about one of the assignments to each student in the course during one semester (spring 1998). The questionnaire, which was voluntary (about one-third of the students actually returned it), simply asked two questions: What was the experience of being forced to make a difficult choice and having to both air and receive disagreement like for you? And to what extent do you think this assignment challenged your own thinking? Students' responses ranged from finding the assignment "taxing" to "not terribly difficult." In general, those who felt the assignment was not terribly difficult addressed it simply as a matter of prioritizing the list of choices, weighing pros and cons, and so on. These students were also the ones, generally, who saw disagreements only as a matter of opinion, stating for example that "I know I will never change my opinions and neither will they (the other students)," or "I rethought all of the possibilities, but overall, I don't think my opinion changed much." In contrast, the students who found the task more difficult (e.g., one student noted, "This was a long-term 'investment' to me -- not just an assignment") responded that their thinking was challenged to a great extent. One student noted, "I got to see a different perspective from my own. A lot of the reason I ranked my choices the way I did was because of the importance my particular high school placed on the subject. Assuming others did the same, I was able to see the views of many high schools and backgrounds all at once." Another student responded, "I got to see many different points from people with different backgrounds. There were reasons for keeping programs that I would never have thought of." Another student replied, "The assignment challenged my thinking because I sat there confused -- here was a question with no right or wrong answer." In other words, I find that, through investing themselves in their choices and then hearing others' ideas, these students began questioning the values and beliefs underlying their own perceptions. Again, though, all of this is based on what I have heard from a third of the class. The question of effects on student thinking still remains largely unanswered.

The second finding I report is that other invitations and opportunities for individual reflection and analysis, some of which were present in the course before the three modifications, have been refined and emphasized during the past two years. The students are invited to reflect through assignments that ask them to: describe what in their background and experience led them to think about teaching, project themselves into various roles presented in a video about school desegregation, analyze and discuss their conceptions related to the purposes of schools, the school curriculum, and images of teachers and teaching. It is evident from my own observations and recollections that more class time is purposely spent on engaging the students in reflection and discussion around these images and conceptions than in previous semesters. Once more, though, I raise the question of the extent to which these activities help to bring about changes in students' often naive conceptions and beliefs. It is my suggestion that we, the instructors and investigators, need to continue seeking methods for the probing of student thinking in this area.

My Reflections

As I mentioned earlier, the four points that follow are less related to the actual changes in instruction and more related to some of my thoughts regarding the changes I have witnessed and described. First, while I recognize the professor's interest in striking a balance with information-input and student inquiry according to a constructivist model, my understanding of the constructivist model (derived in part from my understanding of the literature I have reviewed) places a premium on the importance of student-student and student-teacher dialogue in a community. For this reason, it seems to me that even more in-class time could be devoted to this kind of activity. Richardson (1997) notes how essential conversations are for "internalization and deep understanding" (p. 3). Also, Tobin and Tippins (1993) have suggested that, for every, say, eight minutes of lecture or whole-class interaction, two minutes might be set aside for students to discuss the topic with the person next to them "with the purpose of writing three questions for which they do not have answers," thereby highlighting "the time students need to clarify lesson

elements and make connections with what they know already; it also shows that an important part of learning is identifying questions that need to be resolved in order to better understand given...content" (p. 11).

While this is only an example, not necessarily a solution, the point I wish to highlight is that I believe there is a need for more student talk, both with the whole class and in a small group or pair. It occurs to me that there is too much reliance on the hope that students are going to engage in deep reflection on their own through the assignments noted above. This may be the case, and, judging from at least some of the students' responses on assignments, it is the case. However, my point can be expressed in two questions: (1) How can we (the instructors) know to what extent this kind of thinking is occurring and with which students? (2) To what extent can we expect this individual reflection (if it actually occurs) to bring about the kinds of changes in student thinking we would like to witness? In other words, it occurs to me that not only do the students themselves need to hear and reflect on and debate the thoughts of others, but we (the instructors) also need to provide as much in-class discussion as possible in order to attempt to assess the depth of thought occurring.

My second thought is that, not only is constructivist theory a guiding force for the professor's teaching and structuring of the course, it is also an explicit portion of the content. However, the question becomes, how does one teach students about constructivism without "telling" them about it? I sense that this is an issue with which Professor Myers continues to struggle, and, it seems, from the literature, that he is in good company (e.g., see Meyer-Smith & Mitchell, 1997). Over the two years of this study, it has been interesting to note the rather didactic nature of the professor's instruction in constructivism. Granted, it could be argued, and I would agree, that the structure of the course and the learning activities serve to reinforce this instruction by actually engaging students in constructivist learning. I respond to such an argument, though, with two points: (1) It is difficult, for the reasons noted in the last point above, to know to what extent the students are learning *about* constructivism *via* constructivist/inquiry-oriented learning rather than (as they are probably accustomed to doing) simply memorizing the points made in the professor's explication of it; and (2) If this argument is indeed the case, it seems to me that more explicit and ongoing linkages need to be made throughout the semester to help the students, first, to reflect on the nature of the professor's teaching and structuring of the course, and, second, to connect this with the ideas of constructivism.

The third point I wish to make concerns the professor's explicit intention to engage his students in inquiry-oriented learning. That is, to what extent do the students have opportunity to engage in inquiry related to schools and teaching? My conception of inquiry-oriented learning involves providing the opportunity and the necessary support structures for students not only to uncover and reflect on their own experience, knowledge, beliefs, and attitudes, but also to raise their own questions related to the issues at hand and to set about attempting to construct some answers to these questions as well as further questions to explore (e.g., see Fosnot, 1996; Lambert et al., 1995). From my observations of this course, it seems to me that the kind of inquiry I am talking about here occurs, if at all, by chance.

An example might help to illustrate my thinking here. At one point during the very first class of the semester, the professor begins his introduction to the substantive content of the course by outlining the "initial and persistent questions for the course." These questions are outlined on a projected slide and discussed by the professor. In other words, it seems to me that, at least in this instance, the students are being given (told) the questions they are to ask, rather than being invited to raise their own questions based upon their prior experiences, knowledge, beliefs, and attitudes. My question is, what would it be like if the students, individually and collectively, constructed their own questions (with guidance from the instructor, of course)? I believe that doing this would

help communicate to the students that key sources of their learning in this course are themselves, and that the beginning point for this learning is their current understanding (points I believe to be important dimensions of constructivist theory). I also believe that doing this, at this early point in the course, might help to establish import patterns for the conceptions of learning that the students construct for this course and for future courses.

A final point that I believe needs to be addressed has to do with the extent to which the professor's (and my own) learning during this study could be described as constructivist. That is, to what extent have we been able to learn more about constructivist teaching in college classrooms through (a) uncovering our own prior experiences, knowledge, beliefs, and dispositions, (b) encountering the experiences, knowledge, beliefs, and dispositions of each other and of the other participant-investigators and students, and (c) reflecting on all of these ideas? Of particular concern here is the extent to which we are able and willing to engage in a true conversation about Professor Myers's teaching. In other words, the nature of our relationship outside of this study (professor-teaching assistant, advisor-advisee, doctoral mentor-doctoral student) potentially places barriers that get in the way of serious dialogue among the investigators. Nonetheless, we continue to work through these struggles, as we must if we are to see our own learning occurring in a constructivist fashion. Knowledge construction, ours included, is best when it includes a conversation among what we know and believe, what others know and believe, and the meanings we construct together.

The Technology Assistant's Perspective

As the technology assistant for the course, my roles were to work with the professor in the use of technology in general and to handle the management of the specific technological components of the course. The roles involved chores that occurred both in and outside of class. In general, I provided ideas about the uses of technology and engaged in a wide range of implementing chores. I supplied information on how technology could be used and suggested specific ways to use it. This included, on one level, the sharing of ideas about using technology to convey information and stimulate student thought and interaction; and, on another level, explaining how to work the equipment. I was also the technician-on-the-scene, the trouble shooter for when something did not work as anticipated. I assistant with the course directly for 1996-1997 but only peripherally for 1997-1998.

My focus as an author of this paper is on how the technology affected both the teaching and learning processes of the course. In preparation of this paper, I reflected upon my year-long participation with the course, and I reviewed videotapes of class sessions, archives of electronic communications, and my notes from meetings among the graduate teaching assistants, the instructor, and me as we prepared for classes.

In the introduction to the book, *Technology and Education Reform*, Means (1994, p. 19) envisions technology as a stimulus or reason for change and innovation:

> The decision to devote considerable resources to technology affords an opportunity for deep thinking about what we want to teach and how. Introduction to new software can lead teachers to a different understanding of the field they teach. Moreover, funds for inservice training related to the introduction of technology can provide one of the all-too-rare forums for teachers to discuss what they teach and why.

Although this vision of technology as a force for change is written about K-12 education, it is applicable to any place where teaching and learning take place. It is this vision of technology that I use to frame my observations.

During the summer preceding the first semester in which a technological emphasis was added to the course, the instructor and I attended a series of instructional workshops on the uses of technology. My primary roles were as a tutor for the instructor and as an assistant who could help the instructor implement the technological components of the course that he chose to undertake. In that context, I also explained what was and was not possible or practical to do with the course and what would be involved with the implementation of each new course component.

Early in the first semester of the project, meetings were held to discuss some general ways of making the course more technologically intensive. The professor expressed his desire to create a more "constructivist" or inquiry-oriented environment in the course -- an environment in which students would actively construct their own meanings, interpretations, and knowledge of course topics. These meetings were where we decided what to do in the course and how to do them.

My Reflections

The first noteworthy changes to the teaching process were the obvious and explicit technological changes. As mentioned above, the course was held in a new high-tech auditorium, a room that was wired for sound and for the projection of computer-generated, video-disc, and videotaped presentations. The room easily accommodated the class sizes of 30-50 students. Technological components of the class included visual and sound presentations created on the computer, e-mail assignments, video case studies, class list-servs, and web-based discussion groups.

Another change that occurred because of the adding of technology was in how the professor prepared for classes. Previously, he typically reviewed notes from the past semester, made a few updates, and gathered relevant materials. With the change, however, he planned on a weekly basis with the teaching assistants and me (technology assistant) to develop ways to use technology in his instruction and to arrange for students to use it to create their own knowledge. The largest portion of planning was spent on discussing and developing ways to utilize technology to support a more constructivist environment.

A change that occurred in the learning processes of students in the class involved a new opportunity for them to collaborate and discuss in class and in assignments outside of class. Through the use of e-mail, list-servs, and web-based discussion groups, students were given the chance to construct their own understandings, espouse their beliefs, reply to others, and possibly re-construct their understanding and beliefs. The use of technology in this way seemed to support the instructor's goal of facilitating students' construction of their own knowledge and understanding.

A change that spans both teaching and learning processes also presented itself in this study. This change deals with the instructor modeling the use of technology in class. First, this has been a noticeable modification for the instructor, who had previously not used modern technology in the course. Second, it has been a change for the students (mostly first year freshmen) who, for the most part, had not participated in courses in which technology was used to deliver or support instruction. It is this change that lies at the heart of the college-wide project that initiated this study.

In the context of my observational frame for this discussion, I note that the changes in this course and in the instructor's behaviors occurred primarily because an opportunity to introduce

technology was at hand (involvement in the project). Through the support of this project, which included teaching assistants and a technology assistant, the instructor was able to alter the course from its previous no- or low-technology and information driven focus to a course in which the instructor made heavy use of, and the students interacted with, technology. Both were expected to construct their own knowledge and build on it, and they are doing so.

Finally, I note that technology as it exists today was not available when many teacher educators were learning and beginning to practice their profession. With that said, it is not surprising that many do not utilize it in their instruction today. Many professors tell their students how technology could be used in their classrooms, but this does not seem to be enough. Students need the opportunity to see technology used by their instructors, observe uses of technological tools in classrooms, and practice teaching with technologies themselves if they are to use these tools effectively (if at all) in their own teaching once they graduate.

Summary and Suggestions

In sum, the college-wide project to make this introductory teacher education course more technologically intensive had its desired effect, and, in addition, caused two other changes: it provided the impetus for the instructor to make another significant pedagogical change -- toward a "constructivist" orientation in his teaching; and it forced a change in class location. All three changes resulted in a noticeably different course from that of earlier semesters.

More important than the actual changes in class activities, however, is the change that occurred in the three-person team who conducted the course. Unlike in previous semesters, the instructor, teaching assistants, and technology assistant studied their work closely as a team, planned for changes, experimented, and re-assessed. In the process, they learned together. They analyzed the teaching and learning of the class more than they would have under more typical circumstances. And, the changes, experimentation, and analyzes continue.

It is also important however, to note several limits to what has been occurring with the course over the two years of the project. First, the course is not an experimental course. The changes are within the context of what the course has been for years. They are modifications of course elements, not a redesign of the course as a whole. Second and closely related to the first, the instructor continues to see his primary role as that of a teacher rather than that of a researcher. Third, although the project participants cooperated as a team, their levels of authority have always been different. Evidence of this can be seen in direct comments made be the teaching assistant above and in the fact that the technology assistant reported almost exclusively by describing what happened rather than critically analyzing the instructor's ideas and actions. The instructor, although the primary subject of the study, remained and continues in charge.

On the other hand, all of us are learning much about our teaching and learning, and we are confident that that learning is improving our teaching. We doubt that any of us will revert to our teaching of the past; we know that our learning about our teaching will continue even as our paths as teacher educators diverge.

We suggest that all teacher educators engage in their own type of self-study of their teaching as we have done. Although the results are individual and case specific (we do not suggest that we have developed a model for others to replicate), we are inquiring into our practice and we are enjoying the experience.

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