Tools For Tampering With Teaching's Taboos[1]

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As a young instructor of biology, Craig Nelson asked a senior colleague a question about teaching. The colleague—an excellent teacher himself—made it clear that talking about teaching is taboo in higher education: 'great teachers are born, not made,' he said. Soon thereafter, he came across William Perry's Forms of Intellectual and Ethical Development in the College Years, A Scheme*. It helped him understand his students and improve his teaching. In addition, it encouraged him to break the taboo by investigating other methods of teaching improvement and telling colleagues about them in workshops. He currently serves as Professor of Biology and of Public and Environmental Affairs, University of Indiana, and gives workshops on a wide variety of topics around the country. His email address is <nelson1@indiana.edu>.*

Teaching is like other forms of loving in at least two important ways. First, different concerns emerge at different levels of mastery and maturity. And second, just as detailed knowledge of pair-wise love and love-making were more or less taboo when I was growing up, knowledge of teaching has been essentially taboo in many academic cultures. And I mean taboo in the strong sense—not just failing to teach prospective faculty about teaching and teaching resources, but pretending that there is nothing to be known that can make a major difference in teaching. Beyond the mastery of content, great teachers are born and not made, in this view. Just like Don Juan, it would seem. I have been quite lucky in my teaching career, as I have

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[1]Chapter 4 *New Paradigms for College Teaching.* 1997. Wm. E. Campbell & Karl A. Smith, Eds. Interaction Book Company.

serendipitously encountered some important alternatives at pivotal moments in my development. Or, perhaps more likely, encountering the alternatives made the moments pivotal.

The extent of the change in my views is epitomized for me by the contrast between the answers I would now give to two questions and the answers that were implicit in the ways I initially taught. One of these questions is: "Should we evaluate teaching by what the teacher presents or by what the students learn?" Coming out of graduate school I gave well organized, dense lectures that "covered" a lot of ideas quickly—lectures that were just what I thought I would have learned best from at that time. Indeed, they were much better than most of the lectures that I had indeed learned from! And they were well received by a good portion of my classes. I assumed that the students who did not learn well from them were either dumb, lazy, ill-prepared, or, to be more generous, otherwise engaged.

Although I have since observed that many faculty feel this way, I now see two main problems with it. The most fundamental is that it abdicates all power for change and makes any improvement depend on getting different students. And it is not unusual to hear faculty blame the problems they have in teaching on insufficiently rigorous admission policies. The second main problem with this approach is that it assumes that ones own experience is all the guide one needs to teach effectively, thus the taboo on knowing that anything important can be learned about teaching while simultaneously taking ones self as the measure of all things. (I will turn to the second of my two questions at the end of this chapter).

Initially in all kinds of loving, including teaching, a lot of attention usually falls on basic structure. There are a number of guides to the basic anatomy of teaching ranging from short treatments of basic lecturing and variations thereon (Cashin, 1985; Frederick, 1986) to full blown

handbooks (Eble, 1988; McKeachie, 1994; Lowman, 1984). Indeed, most of us learn in graduate school how to organize content and present it in talks, seminars and lectures. But often when we leave graduate school, lecturing is really the only teaching mode in which we are semi-competent.

Active Learning

However, a key thing in outstanding teaching, and outstanding love-making generally, is to move beyond basic anatomy—to be able to do more than one thing well. In teaching, we must be able to do something besides just taking-in and spewing-forth knowledge. The acquisition of alternative teaching moves thus becomes central. In most classes this means somehow mastering a variety of discussion and other active learning techniques. A few of us come naturally to discussion, finding it easy to keep track of who said what while guiding the discussion and managing the class. I was not—and am not—one of those people, and I do tend to think of that talent partially as something one is born with, a facet of personality if you like. What the rest of us need are active learning techniques that are robust enough not to depend on our personalities—robust enough to be largely goof-proof.

Active Learning Example: Quick Pairs. Perhaps the single most useful teaching move I have learned is a technique that seems able to elicit engagement and discussion from any class. For mnemonic reasons lets call it Quick Pairs or PWPH: pulse, write, pair, and harvest. The pulse is an initial stage that gets each of the students prepared for discussion. It can be, for example, a brief silent (i.e. individual) consideration of a paragraph in the reading or a segment of lecture. I then give the students a question to answer and time enough to formulate their

answers in writing. I usually wait until about half have quit writing. With experience one can announce the time first ("take two-minutes to sketch your answers")—though I still tend to adjust the time according to the students' non-verbal behavior. I then ask the students to "compare your answers with your neighbors, in groups of two or three." I time this paired phase by listening to several pairs of students and watching the non-verbal behavior of the class as a whole. I usually announce "two-more minutes" or "one more minute" at approximately half-way through the pairing. After these brief collaborations many students spontaneously participate in class discussion. Moreover, students typically regard it as fair for faculty to further harvest the results by calling on them individually for a report on their pair's ideas—even though they would often resist being called on individually without the prior, preparatory interchanges. Typically, this will allow me to engage any and every student in large group discussion, if my purposes are well served thereby.

This example illustrates the kind of active learning that I have found both most effective and easiest to use, especially with students with little prior experience in serious collaboration. I think of it as teacher-structured and student-executed. I see three main tasks that teachers usually need to take responsibility for: assuring preparation, structuring the social roles, and providing intellectual scaffolding.

Making Active Learning Work: 1. Assuring Preparation.

The Quick Pairs or PWPH approach as applied in a large group illustrates how teachers can be responsible for having the students prepared for discussion. In lecturing "to" freshman courses, I find it very helpful to stop every five to ten minutes and use this technique. The initial

lecture segment prepares the students for the writing exercise (and the knowledge that an exercise is coming focuses their attention on the presentation). The writing exercise in turn prepares them for the discussions with their neighbors.

The importance of this move is evident in the flip definition of an extrovert as someone who really likes to start a sentence out-loud hoping to find out where it ends. Introverts, in contrast, hate the very idea of starting before they know where the sentence ends. An initial period of writing thus prepares the introverts for talking with their neighbors and helps the extroverts refine what they are going to say—thus improving the small-group participation of everyone. The discussions with their neighbors in turn prepare the students for participation in the larger group, partly by letting them rehearse what they will say, partly by getting feedback that they are on an interesting track, and partly by letting them decide to talk about their partner's ideas if they find them more interesting than their own initial efforts. At each stage the teacher has thus taken responsibility for having the class prepared for the next step.

As an alternative starting point I often have students read an assignment before class and prepare several questions for a possible quiz. The discussion in class can then focus on the more interesting of the prepared questions. And the frequency of actual quizzes can be adjusted to maintain a satisfactory level of preparation (I prefer nearly 100%).

Having students prepare a one- or two-page written analysis before class and then modify it in class will profitably sustain a period-long discussion. In this case, I insist that the students use in class a color of ink that contrasts markedly from the one in which they prepared the assignment—this makes it quite easy to see whether each student has prepared for class. And by making the fraction of the course grade proportional to amount of effort required in preparation

for discussion, and by giving zeros for failure to prepare, I find that on most days all of the students will come to class with the assignment prepared.

Again, this illustrates the idea of the teacher taking responsibility for setting up a system in which the students are prepared for active learning. And the central point is not that one should use any particular technique. Rather: active learning works best when the teacher takes this responsibility seriously.

Making Active Learning Work: 2. Structuring Social Roles.

Once the students are prepared, the teacher must structure the discussions so that they work both socially and intellectually. Quick Pairs (PWPH) and similar methods rely for social structure on the students forming groups and taking turns. In the group formations phase it is often helpful to say "look around you and make sure everyone is included in a group of two or three." Turn taking can be greatly facilitated by announcing, "one more minute" or "two more minutes," at which point anyone who has not yet participated fairly will usually be asked by their partners to share what they have written or thought. Frequently the discussions become even more animated at that time, and I often allow them to extend beyond the announced time, relying on the intensity of student engagement and on listening to student comments to pace the ending time, which I usually announce as "20 more seconds—finish your sentence" and "10 more seconds—let's pull back into the large group." Sometimes I have to then begin talking to fully regain the classes attention—frequently by asking a student to share what her group concluded. Out of a desire to hear this student, others in the large group will then hush anyone who is still talking in a small group.

The essential point here is not any particular move by the teacher.   But rather, discussions and other active learning arrangements will work better if the teacher is monitoring the social interactions and has at hand ways to make the interactions more effective.

When student interactions are relatively brief—a few minutes—groups can be small. The main tasks are typically sharing ideas and finding and modifying partial understandings of the material and its applications. Many topics benefit from more prolonged discussion than pairs can reliably sustain, often because the task requires more understanding than the average pair of students brings to it. In these situations more of the responsibility for the social processes must be explicitly built into the groups.

One of the pivotal moments in my development as a teacher was a demonstration by the late Dr. Judith Hanson of an approach to discussion that she used in classes of at least 125.   She had the class prepare a written assignment and bring it to class together with a pen of a different color than the one they had used in preparing the assignment. She then broke the class into groups of five and had them discuss the topic and modify their work. This allowed her do a rough assessment of extent of preparation simply by scanning the papers during the discussions. She and one graduate student would monitor the groups and give each student a grade for participation dynamics and, later, a grade on the written work that took account of both preparation and the modifications. The students were deeply and effectively engaged in the demonstration discussions and I was inspired to try this in my own classes.

I have found several teaching moves that help make the social dynamics work when using Hanson's approach with groups larger than two or three. One is managing the group size. I try to keep the groups to fewer than eight students, with five or six being ideal. Large groups often

fragment into side conversations and groups that are too small may not have enough insights and differences in perspective to sustain a period-long discussion.

I have also found it helpful to assign students to groups. Usually I do this by deciding how many groups I want and then having the students count off. One time we count off along the rows. The next we count off in some erratic pattern—thus making it impossible for students to control who they will be with. When in contrast I have let groups form spontaneously and last for several weeks, I have often had problems. Some groups will include too many students who are trying to disengage from the course. Some groups will be disproportionately good students—they will be pleased but other good students who are not in the groups they perceive to be best will feel disadvantaged. And most of my classes seem to include at least one person (in addition to myself) who is hard to get along with. With permanent groups, other students feel trapped with this student whereas when the groups reform for each new task they typically feel they can take their turn almost happily. Rotating group membership also increases the number of their classmates whom students know well enough to consider including in their study groups.

In some classes longer discussions may tend to wander progressively off course. This can be fairly easily prevented by providing a more structured agenda or another more carefully specified task—for example, going over a worksheet or set of questions. It is also quite interesting and effective to wander slowly around the room listening to some groups while watching others part of the time and actively and visibly watching the group you are listening to at other times. The first allows better monitoring and the second allows more direct encouragement.

For larger groups to work well, it is essential to make the group responsible in part for keeping everyone involved.   One can easily monitor the dynamics of up to a dozen groups of students as long as one is not trying to keep track of the content of their discussions (evaluation of content is handled by evaluating the worksheets). If a student seems not to be participating actively in the discussion (not just actively listening), I lower the participation grade for every student in that group unless the other students are repeatedly inviting that student to share what she or he has written. Even quite extreme introverts can usually participate if they can read what they have written and if the group spontaneously asks them to share it. With the group taking responsibility, I almost invariably get 100% participation in group discussions.

However, it often takes more active intervention to keep some students from monopolizing the discussion. As an introvert, I initially tried suggesting that people who were dominating discussions should shut-up more. This was spectacularly ineffective and counterproductive. I eventually learned to suggest that since they were good at getting the floor they needed to learn to use this skill to involve those whose views they did not yet understand. I give them an A- the first time I note this on their paper, a B and a more elaborate set of comments the next time if necessary, and a C and invitation to come and see me if the B and associated comments were insufficient. I have found that almost everyone can learn to pass the floor in the face of rapidly declining grades. Although this sounds harsh, I have never had a student complain about it on the course evaluations. Instead, I have had a number of students comment that this approach to group dynamics led to the first real discussions they had ever experienced.

Once again, the central lesson here is not that one should use a particular approach but rather that active learning will work better if the teacher has taken responsibility for providing a framework that structures social roles. One further example will show how large the benefits can be.

Active Learning Example: Complete Turn Taking. The benefits that can be gained from structuring the social roles is illustrated by a method I think of as complete turn taking that I learned in a workshop given by Dr. Barbara Olive of Concordia College. For preparation, the students read an assignment and write-out answers to some open-ended questions. In discussing their answers and reactions in groups of three to five, each person in turn gets to continue without interruption until she or he formally announces "I'm finished." Then each in turn notes the positive things she gained from her collaborators insights, terminating again with "I'm finished." Thereafter the collaboration is unstructured.

This produces unusually effective communication. In less structured modes, if I have a new idea and pause to get it straight, someone else starts talking. If, alternatively, I suddenly realize how the material at hand sheds light on my personal history and pause to decide whether and how to share it, someone else usually starts talking. Moreover, in unstructured exchanges, we often puts more energy into thinking about what to say next than into listening. But here what one is going to say depends on one having listened closely to what ones peers have to say. The complete turns approach thus fosters more careful listening, greater freedom to develop ideas, and clearer statements of consequences and values. Some dreamers even argue that such an approach might be applicable to faculty committee meetings.

A number of books are now available that provide additional approaches to active learning and additional methods for assuring that one's students are really prepared for structuring the social dynamics (Bligh, 1986; Gabelnick et al. 1990; Johnson et al. 1991; Myers and Jones, 1993; Whitman, 1988)

Making Active Learning Work: 3. Intellectual Scaffolding

Once we have structured our classes so that the students are almost invariably prepared for the active learning opportunities and so that the social roles work during active learning, we can turn to the question of how to maximize the gain.   This might seem like an unnecessary question since active learning itself tends to be better than lectures in producing retention, comprehension, application, synthesis and student enthusiasm and satisfaction (McKeachie, 1994). However, my own first attempts at using discussions were not very successful because I mistakenly thought that all one needed to do was have the students talk amongst themselves.   I find instead that providing some intellectual scaffolding or framing can radically improve discussions.

Consider first the Quick Pair method. Rather than simply saying discuss this with your neighbors, it is more effective to ask particular questions. I usually either use questions that draw out connections and implications or ones that are like the questions, or parts of questions, that I might put on the exam (or other assessment) over the material being discussed.   This has three effects. It increases the importance of both the preparation and the discussion in the students' eyes. It allows the students to think together more effectively. And it allows them to rehearse

kinds of thinking that you want them to do but which might otherwise be beyond many students' reach.

Longer discussions will require more careful scaffolding to achieve these same goals. This can be in the form of an outcome that must be produced—a report to the larger group, for example. Or it can be in the form of more demanding analyses to be done and reviewed. Let me give an example of the latter.

Active Learning Example: Worksheets For Intellectual Scaffolding. When I want to produce deeper understanding of complex issues, and of ways to deal with complexity or controversy, I often have a class fill out an evaluative worksheet before class. A typical worksheet asks for the author's main points, the support offered for each, an evaluation of the strength of that support, and a statement of the burden-of-proof that the student advocates for each point. Burden-of-proof is a choice between the skepticism of the scientist who usually "rejects the point until it is shown to be probably true" and an alternative that "accepts the point until it is shown to be probably false." Either choice must be justified by an explicit statement of the consequences on which the student bases the choice and by a statement of the strength of evidence that would cause the student to reverse her conclusion. This approach takes uncertainty and adjudication as foundational and further asks the student to justify choices in terms of the consequences and their value (see Nelson 1986 and 1989 for examples). It thus uses intellectual scaffolding to elicit higher-order critical thinking.

Critical Thinking

There are several different major approaches to fostering critical thinking in college (Kurfiss, 1988). I have earlier discussed how to fit three of them with active learning (Nelson, 1994). I want to concentrate here on the approach that sees fostering critical thinking as a process of producing cognitive development. This approach was as fundamental to the transformation of my own teaching as the discovery of failure-proof discussion methods.

In this approach the deepest difficulty in fostering critical thinking comes from our unchecked expectation that students already have developed the intellectual capacity to understand the ways our disciplines work. It is helpful to distinguish several capacities that we want students to master. One includes such basic right-answer reasoning skills as syllogisms, understanding area and volume in terms of unit squares and cubes, and understanding (not just executing) mathematical operations. I term this level complex-correct thinking: there is a correct answer and usually a correct way to get there but a lot of thinking is required, as anyone who has learned at least some calculus can testify. Arons (1990) provides a longer list including both general and quantitative reasoning skills.

Piaget (e.g. 1967; see also Arons 1990) provides a framework that explains many of the problems delineated by Arons and others. Children initially acquire skills in concrete tasks and only with more experience and maturation become capable of dealing with ideas and reasoning operations in the abstract - i.e. "formal operations." Understanding mathematical equations without needing to think of specific concrete examples and understanding the concept of a tragic hero rather than just picturing particular heroes provide examples of formal operations. In many institutions a majority of entering college freshmen are not yet ready for courses based on formal operations (e.g. Arons), but many first-year courses require them. Herron (1975) lists 16

"competencies" integral to freshman chemistry that appear to require formal reasoning. Arons provides extensive examples of how we can help students master complex-correct formal reasoning tasks.

However, even students who are fully competent at formal operations may still not be capable of many of the tasks faculty usually characterize as critical thinking. I have asked over 3,000 faculty in workshops to envision the critical thinking skills they would like to teach. Well over 90% of the tasks specified require understanding beyond the right-answer focus of basic formal operations. Perry's (1970, 1981) scheme of intellectual development helps us understand some central tasks faced by students after they become capable of formal operations.

Perry found that students typically enter college with a simple view of knowledge, one that greatly limits their ability to understand complex issues. Subsequent studies have confirmed the basic pattern he found while considerably enriching our understanding of the varieties of experience subsumed under the overall pattern (e.g. Basseches, 1984; Baxter-Margolda, 1992; Belenky et al., 1986;, Kitchner and King, 1994). As a first approximation to understanding some of the significance of these studies for learning in college students, I find it useful to simplify the findings to a series of four approaches that the students take to learning and to focus especially on the three transitions between the four approaches.

Approach One: Dualism or Sergeant Friday

In this approach, the intellectual world is seen almost exclusively as red or white with few things being pink. Real knowledge is assumed to be unambiguous, discovered, and eternal truth and falsity is equally clear and permanent. Misspelling and wrong additions provide concrete

examples of what is taken to be the general state of knowledge. Perry termed this approach "dualism."

In such a universe the roles of teacher and student are quite clear. Students, like the famous TV detective sergeant, want "just the facts ma'am" and mostly expect to memorize them, at least for long enough to pass the exam. Teachers are seen as gigantic fluorescent yellow highlighters. We are supposed to tell students what parts of the text are important enough to be memorized. We are not supposed to add anything to the text—there is plenty there already. And we are certainly not allowed to disagree with the text. The students have a clear view of the hierarchy of authority and if we were that smart we would have written the text. Right? And besides, if the text isn't right why are we using it? And, worse, how could anyone decide what part of the text to trust and what to discard?

Although this approach severely limits students' abilities to understand complexity, partly by seeing complexity as due to the incompetence of some authorities, it does allow students to do two things that are helpful as a base for complex thinking. First, a dualistic approach can be used to master a base of information, though the significance of the information may be quite elusive. Second, even though students are taking this approach to a course, they can learn to do the form of critical thinking that I termed above "complex correct thinking"—the thinking required to solve problems where there is a single right answer and the teacher has taught the students "the way" to find that answer.

Much teaching of freshman courses, especially in the sciences, focuses on the two tasks that dualists can do well: memorizing information and solving right answer problems. Partly, I think, this is because teachers have found that such teaching works, in the sense of letting the

15

students pass exams. However attractive this seems, I now question its appropriateness.

Students seem too often to mistake knowing something for the exam with having usefully

learned it—and are often insulted if one wants them to remember it later.

Transition One—Legitimate Uncertainty

Sometimes students take the Sgt. Friday approach to an area because it is new to them

and they have no mastery of its complexity. Sometimes they take that approach because it is the

core way they think about most or all intellectual matters. Either way the first key intellectual

task in a course is understanding that uncertainty can be legitimate and is often pervasive, even in

areas such as science that are popularly thought to be laden with truth. No one can think

critically about things that seem unquestionably true. However, dualistic students so resist

uncertainty that they may suspect a teacher's competence if shown two ways to work a problem!

Therefore, a basic question for teachers is, "How can we help the student understand the

extent of the uncertainty in what we teach and its legitimacy or sources?" And understanding of

both the extent and the sources is essential. If the students just understand the possible sources

without understanding the extent, they will often assume the uncertainty is just a theoretical

possibility and that for practical purposes the material is eternal truth. More sophisticated

students often take this approach to science, for example. On the other hand, if students see that

uncertainty is rampant in a course but do not understand its sources they often seem to assume

that this is the teacher's fault—if the teacher were more competent, the truth would be clearer.

Alternatively they assume that a particular area of knowledge is aberrant. When I began trying to

teach ecological biology so as to produce intellectual development, students repeatedly said

things on their evaluations such as "Nelson is a pretty good teacher but it is a shame that ecology is so uncertain—they should let him teach some real science sometime."

One very powerful tool for helping students understand that knowledge is in practice quite uncertain, even in "real" science, is to focus on the long term and short term history of knowledge. I sometimes ask students what physicists 100 years ago would have "known" to be absolutely and certainly true and beyond all possibility of doubt but that we now know to be wrong nevertheless. Important answers include: space was thought to Euclidian, motion was thought to be Newtonian, and matter was thought to be indestructible. It is of course important to focus on more recent shifts also, bringing these to bear on the course at hand. In biology the history of the "central dogma" in which information can flow only from DNA to RNA (precluding HIV) and of our explanations of why sex exists provide telling examples. More generally, the gradual demise of the dominance of "modernist" ideas and the emergence of "post-modern" alternatives provides a plenitude of examples.

A discussion of the sources of uncertainty also depends closely on the material in the course. In science we can focus on the failure of logic to yield certainty. If logic provided truth about reality (rather than about imaginary universes which ours only approximates), then space would be Euclidian, rather than being a function of the distribution of matter, and two quarts of alcohol added to two of water would be a gallon rather than distinctly less (they dissolve in each other).

A central question then becomes: "How can knowledge be both uncertain and useful?" I like to take this one level further and ask how scientific knowledge can be wrong and still be

useful—since if wrong ideas can be useful then uncertain ones surely can be useful too. For this I turn to the brilliance of the flat earth model.

A Key Example: The (Nearly) Flat Earth. In understanding the flat earth model, it is good to begin by asking how the curvature of the earth compares with the flatness of a small pond on a still day. How much would the pond dome up in the middle if it were rounded like the earth instead of being so wonderfully flat? And the answer of course is that the pond does dome up in the middle to exactly match the earth's curvature. As indeed it must if the oceans are to encircle the globe.

One can also ask how smooth the earth is. Physicists have assured me that if one wants to understand how smooth the surface of the earth is, one should look at a large ball bearing that has been carefully hand polished until it is a perfect mirror. If it were blown up to the size of the earth, keeping the surface irregularities the same proportionally as they are on the ball bearing, it would then be much rougher than the surface of the earth. So the earth is as flat as the surface of a pond and as smooth proportionally as a polished steel ball.

Moreover, the flat earth model is the most widely used model of the shape of the earth in practical human applications like architecture and engineering, just as Newton's laws of motion and not models of relativistic effects are the models most frequently used in human affairs such as designing cars and airplanes. Indeed, I first began to really understand the importance of uncertainty in our knowing when I realized that the flat earth model has the same scientific status as we enter the twenty-first century as Newton's laws of motion. Both capture important pieces of reality. Both are of immense practical importance. And both are quite wrong and wrong in exactly the same sense: each is a quantitatively-good first approximation that fails on larger

scales. It then dawned on me, and I try to use this example to help students understand, that all

of our current scientific models may ultimately turn out to be useful in this same sense and wrong

in about the same sense too. It matters that the subjects we teach are largely current versions of

ideas that will probably eventually be seen like the flat earth model is now seen.

Some theorists emphasize the importance of tangible stories or examples in our students'

understanding of new ideas.[2] I have developed the flat earth idea here as an example of the kind

of touch-stone we need to provide our students if they are to apperceive the ubiquity of

uncertainty and the way that things can seem true and be quite useful while still remaining

uncertain or even being wrong. Alternatively or additionally, stories like this illustrate how

theories can match a lot of data without being proven: almost any attempt to measure the

curvature of the surface of a small pond (without the use of lasers) will erroneously show that it

is indeed quite flat.

Approach Two: Multiplicity or "Baskin Robbins"

When the students first see that there is no guaranteed right answer in an area, they

typically conclude that all opinions must be equally valid. Lacking any better standard, they pick

an opinion because it feels intuitively OK, much as one might pick a flavor of ice cream. Perry

termed this stage "multiplicity". Most graduates from most four year programs have multiplicity

as the most sophisticated mode they use spontaneously in thinking about real problems (Moore

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[2]For example, see Nel Noddings, *The Use of Stories in Teaching*, chapter 1 of this
book—ed.

1987). In this sense, liberal and professional education generally fail even for most students we graduate!

Transition Two: Comparisons and Criteria

The transition from dualism to multiplicity requires that students recognize the inevitability of important uncertainty on many questions. The transition from multiplicity to greater sophistication requires the recognition that despite this uncertainty, one can often select one or more ideas or other human productions (be they poems, scientific theories, nursing plans or whatever) that are superior to most other comparable productions or, alternatively, that although there is a fair range of acceptable productions, many others are demonstrably terrible. Our primary teaching task becomes showing how we recognize better from terrible or vice versa in our disciplines.

Most people have heard of the big bang theory for the origin of the universe. Relatively few know that this model predicts that matter will have been initially spread so evenly that galaxies would never form, a prediction that has been understood for decades. Despite the elegance and power of the big-bang theory, there are of course a few individuals who believe in the existence of galaxies simply because they can see them or see photos of them! Put differently, the big-bang theory has been known to be wrong for decades. How can it then be that everyone is still taught it? It is taught not because it is right but because it is better.

When we claim that one theory is better than others, two questions immediately arise. Better than what alternatives? And better on what criteria?   The big bang set of models is better than models that assume an unchanging universe and better than models that assume a steady

state of endless change—better because they account for the cosmic background radiation, the changes in the average composition of stars through time and certain other features of the universe that are left unexplained by the other models.

We can foster critical thinking more effectively if we explicitly delineate both the alternatives and the criteria we use to adjudicate among alternatives (Nelson 1986, 1989, 1994). Thus in teaching evolution my goal is not student belief. Rather, my task is to help students master the criteria used in science to judge which theories are better so that they can compare evolution with any proposed alternatives (Nelson, 1986).

In teaching, I attach special importance to ways of testing theories that are "fair" both in the sense that they are based on new discoveries and in the sense that they could have supported each of the alternatives being compared. Radioactive dating provides a good example of a fair test. In this case the competing theories are that the earth is quite young, that it has to be less than 100 million years old as advocated by Lord Kelvin, and that it has to be of much greater age. It is fair because none of the original theories are based on radioactivity and fair because it could have shown that all the rocks on earth are less than 10,000 years old or that they are all less than 100 million years old. Instead it showed that the oldest rocks are about four billion years old.

Approach Three: Contextual Relativism or "Teachers' Games"

As students learn to use criteria to separate stronger and weaker productions, they begin to treat intellectual activity as games, either teachers' games or disciplinary games. These are seen as games in two senses. First, there are good and bad moves and the student can tell the right moves within the rules of the class or discipline. Further, students have a choice of playing

21

or not playing. There is a strong element of sophistry: instead of the "any opinion is equally

good" of multiplicity, students now often still think privately that any framework is equally good

but that within a disciplinary framework one can tell better from worse and otherwise proceed to

make sense of the chaos of uncertainty in a way that is satisfying to the teacher if not to ones self.

"Contextual relativism" describes this stage.

Why Games Are Not Enough: Developing Intellectual Empathy

The necessity for further development can be seen if we examine the development of

empathy (Belenky et al. 1986). When we treat issues as dualists, we rely on an authority to

provide the answers. We see no validity in asking why authority chose those answers: authority

chose them because they are the truth. Since we don't understand why our group believes as it

does, we have no base for understanding why other groups believe differently—they are simply

wrong. Indeed, we frequently regard other views as not just factually wrong but also as morally

wrong—as evil (Perry, 1970). Thus we have no base for either intellectual tolerance or empathy.

In areas we treat with multiplicity, we believe that authority cannot provide dependable

answers. If we must pick an answer, we do so unreflectively (again, like choosing ice cream).

Thus, we have no articulated understanding of our choice and, hence, no grounds for intellectual

empathy. But we want others to tolerate our choices and thus expect to tolerate theirs. This

leads us to try for unlimited tolerance in areas where we see that there are no clear answers.

In the intellectual "games" of contextual relativism, we understand that people living in

different contexts often legitimately believe differently. We may even take as one of our central

tasks the attempt to understand how intelligent, even brilliant people (past and present) ever

came to believe things that are so different from those we currently believe (Russell, 1945). We are thus rapidly developing the capacity for intellectual empathy. But we still have unlimited tolerance for different frameworks of belief. Great tolerance might seem to be a virtue, but students here often carry it to extremes. Given an introduction to modern German history, they can see that in many ways Hitler was brilliant and effective. But they are reluctant to say that key parts of what he did was wrong or crazy (Belenky et al. 1986).

Transition Three: But Games Matter

To make such judgements, one has to assert one's own values as preferable. One has to begin to take stands again, as one once did in dualism, but based now on an articulation of one's own values and analyses and not just as an echo of authority's positions.

How can we best foster this third transition, the one that allows deep professional competence and sophisticated ethical judgement? One way is to provide students with a model of how to make such judgements. Indeed the provision of just such an intellectual scaffolding was the rationale underlying the development of the burden of proof worksheet described above.

In verbal presentations of his findings, Perry often emphasized that students at this level have just one question of you as a faculty member: "Are you alright?" The student can see that this new approach to knowing requires both that she leave behind many of her earlier views of why things should be and that she accept considerable responsibility for herself and her world. She wants to know if you are happy enough and moral enough. Who the teacher is becomes an essential part of the learning experience in a new and deeper way.

Put differently, students need to see us as faculty modeling the taking of stands securely grounded in our values in the face of uncertainty and complexity. One way to do this is to articulate for ourselves the answers to questions such as: "How are my personal values reflected in the choices I make as to what content to teach and what not to teach?" and "How are they reflected in the choices I make as to what pedagogical approaches to use and not to use?" Once we have these articulated for ourselves, we can share them with the students, thereby modeling mature thinking in the area that matters most to them—the ways we teach them.

By now we have blithely crossed several layers of the taboos that surround teaching. Not only are we looking at ways that teaching can be done better, but we must ask whether the ways our disciplines have traditionally been taught, or the ways our graduate professors taught, are the most effective ways for our particular students. And in many fields there is a further taboo against seeing that teaching is always at least implicitly teaching about values—both in the content choices and the choices of pedagogies.

Approach Four: Personally Affirmed Games

To operate as sophisticated adults, we must combine "games" and adjudicate among various combinations in different contexts. Thinking becomes more complex. We come to see knowledge as constructed rather than discovered, as contextual, as based inevitably on approximations, as involving tradeoffs among conflicting values, and as requiring of us that we take stands and actively seek to make the world a better place (Belenky et al., 1986).

We come to understand that to do significant good one must risk doing harm and that to do great good one must do significant harm (Levinson, 1978). We understand that a doctor who

is unwilling to risk harming us is useless to us. Aspirin kills people. Other powerful drugs also have significant, occasionally lethal, side effects. Doctors must accept that some of their patients will be harmed or die from the side effects of drugs and treatments appropriately administered and from the consequences of appropriately withholding drugs and other treatments. And that is without any mistakes! Tradeoffs and risks are the rule not the exception in important real world decisions.

When we as faculty fail to get students to this level of critical thinking, we leave them poorly prepared to deal with personal and professional decisions and with the major issues of our times. Diversity, social problems, environmental issues, and the changing geopolitical system all require minds that can grapple successfully with uncertainty, complexity and conflicting perspectives and still take stands that are both based on evidence, analysis and compassion and deeply centered in values. This ability must be a major goal of liberal and professional education. I have one more major tool to offer in this regard.

Maps for Students (and Teachers)

Ideas of conceptual maps have gradually acquired a central place in my thinking about teaching and its improvement. In proposing an introductory freshman seminar last year, I asked myself what maps I could provide that would help students frame their educational tasks—help keep things in a larger perspective and thereby make them both more doable and more educationally effective. Three quite different sets of idea came to mind.

The first is a one-dimensional map, a spectrum. It is useful to consider the span from naive realism to full social constructivism. In naive realism, of course, our ideas accurately

represent an external reality. Descriptions of mineral crystal axes or legs on a grasshopper serve as nearly indisputable examples. And, from the students' point of view, so would the names of the characters in book and its basic plot structure (when unambiguous). At the constructivist extreme, our ideas are subject to few or no constraints from external reality and what we collectively think is (almost) totally a matter of social agreement. At the concrete level, examples are provided by the questions of what hair styles or clothing choices are appropriate for what interior environments (where neither hair nor clothes address any physiological needs). The shocking thing, from a freshman's point of view, is that most of this range is now "contested terrain."

Hence the power of this one-dimensional map. It allows us to ask questions like: Where does the author (or the professor) think this issue or question falls along this gradient? And where do I think it should be placed along it? Anderson's (1990) book, *Reality Isn't What It Used To Be,* provides a fine, student-level introduction to the issues at stake in this contested terrain. For science, see also the chapter on "Believing where we Cannot Prove" in Kitcher (1982). For more advanced students, depending on discipline, try Kline (1980; the preface is widely useful and thought provoking), Strahler (1987), or Novick (1988, Chapter 13 "But the Center Doesn't Hold" and references therein).

A second map of the modern intellectual landscape is that of disciplinary discourses. A major problem for many students is that faculty often act as if (and may even believe that) they are teaching and thinking in English, rather than in some arcane disciplinary dialect. The dialects, of course reflect larger cultural distinctions. It is sometimes helpful to describe science as dealing with questions of external reality and pretending that questions of internal response

and meaning have no relevance or even no validity. Much of the humanities, in contrast, deals with internal reality. Here the questions of correspondence to external reality are reduced in many cases to the issue of plausibility. No fact in a work of fiction need be literally true, only plausible in context. We judge the work by its correspondence with or relevance to an internal reality of motivations, feeling and emotions, and values.

A closer look at this landscape shows that disciplines (and sub-disciplines) differ in the questions emphasized and in the standards for judging answers to those questions. Freshmen typically think that a text means what it says. But the same novel used in literature, women's studies, economics, and sociology classes means quite different things across the different courses. Students can be quite surprised and empowered by the ideas that the significance of a book is determined to a large extent by the questions one brings to it and that these questions differ markedly among courses; similarly for the standards by which one judges the quality of an answer. Bruffee's works (e.g. 1984, 1994) provide an introduction to this perspective.

Ideas of intellectual development (Perry and other references above) provide yet a third map that is quite helpful to students. At one level, these ideas help students articulate for themselves the differences between how they would have tended to think of the material in a course and the ways in which faculty typically want them to approach the material.

These three maps allow me to illustrate four points that are central to the processes of improving teaching. First, many faculty are like most freshmen. They are perforce on a journey but they have often not acquired any maps. With no maps, with no sense of where one is trying to go, one often mistakes any movement for progress or, worse, mistakes where one is for the center of the universe, the only reasonable place to be, the only reasonable way to think or to

teach. Second, teachers often find that maps such as Perry's scheme provide powerful guidance

in deciding what teaching moves are more appropriate at a particular time for a particular student.

Third, the provision of new maps as students are ready for them can be a critical teaching move.

So too, the issues presented by new maps of teaching can be a critical move in changing our own

teaching or in fomenting change in others. Fourth, the three maps I have presented are

fundamentally each about the same larger terrain, but each brings out a different perspective.

The overall question is not which map is right, but rather which set provides the most useful

guidance and promises the most enjoyable journey. Moreover, as Allan Watts once remarked,

we in the West are always in serious danger of mistaking the map for the terrain. Having a set of

overlapping maps helps us avoid unduly reifying any one map, whether as students or as

teachers.[3]

Values and Teaching

The existence of multiple maps and the unavoidability of a guided do-it-yourself or

constuctivist approach highlights a central issue for teaching: Is one inevitably engaged in a

process of values modification or reinforcement? It is attractive to claim that the goals of

teaching are really value-neutral. In reality, maps like these let us see that college teaching is

always a process of values inculcation and values advocacy.

What values? Whose values? The values taught vary with the pedagogical and content

choices the teacher makes. One pervasive value in higher education is that we should prefer a

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[3]cf. Donald Dansereau and Dianna Newbern, *Using Knowledge Maps to Enhance Teaching*, chapter 7 of this book—*eds*.

position supported by evidence, justified by comparisons with other positions, and checked for consequences. We should prefer this position over, for example, one chosen because authority tells us it is right.

This fundamental value of academia conflicts with the values students bring to us from many sub-cultures and the training many of them have received in previous schooling. Teachers may choose not to challenge authority-based universes for a variety of reasons, but this choice has severe consequences. It leaves students with less powerful ways of dealing with the complexities of professional, social and personal lives. And it leaves them less capable of understanding current intellectual and political landscapes. This is especially problematical for those issues where informed and effective responses and initiatives are crucial to the quality of our lives in the next several decades. In my mind these include: social structure and the limits of permissible economic disparity, environmental quality and resource use and conservation, and the appropriate applications of limitations of new medical and information technologies.

In the introduction I emphasized that the extent of the change in my views is epitomized for me by the contrast between the answers I would now give to two questions and the answers that were implicit in the ways I initially taught. The first question was: "Should we evaluate teaching by what the teacher presents or by what the students learn?" My answer has switched from the former to the latter. The three main approaches I have treated here, teacher-structured active learning, fostering intellectual and ethical (cognitive) development, and providing students with maps that allow them to take an overview of their education as a whole, are the most powerful ways I have found to foster student learning.

Once we focus on fostering student learning, a second question arises naturally: "To what extend do we want to sort students and to what extent do we want to foster high levels of achievement by as many students as possible?" Although we would like to be able to answer "both," I have found that these two goals can be in substantial conflict.

For example, in courses I teach I often give out the question pool, or much of the question pool, as I assign the readings and other work. Similarly, when I write an exam I often write a second exam over the same material. Students who don't like their grade on the first exam (or who wish to skip the first one to concentrate, for example, on other courses) may take the second one with the higher grade prevailing.

These approaches considerably increase the proportion of the class that achieves the level of work that I have customarily called A. It decreases my ability to sort students, however. I also believe that it increases the accessibility of my courses to students from non-dominant backgrounds (see also Nelson, 1993). I have even begun to wonder if our goal should not be to see if we can eventually come to evaluate our teaching by the proportion of our classes that legitimately earn an A.

That radical thought deserves some pause. A mature Carl Rogers (1961), in sketching his views on teaching, noted "when I consider the implications . . . I shudder a bit at the distance I have come from the common sense world that everyone knows is right." I think that all of us who have made major shifts in our pedagogies have shuddered a bit at times. Such is the force of taboos. And thence the constant need for a loving reconsideration of what we are about—to make sure our teaching reflects our intentional, caring choices rather than the shadowy dance of taboos brought unthinkingly forward from earlier contexts and times.

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