

teaching and testing in the modern world

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**I am always ready to learn, but I do not always like being taught.
--Sir Winston Churchill**

And therein lies the rub. It is great fun to learn something new. It is even fun to fail and try try again while learning something new. What is definitely not fun is being embarrassed because you can't do something or don't know something. It makes you anxious to appear stupid in front of others. Teachers would be great to have around if they were there only when you needed them.

I'll be back when I need you again.

Hana Schank, age 5

I couldn't resist quoting my daughter here. I thought this statement of hers was so cute at the time that I wrote it down. Later I realized it was profound. It sums up any child's attitude towards being taught.

Socrates. Well, my art of midwifery is in most respects like theirs; but differs, in that I attend men and not women; and look after their souls when they are in labour, and not after their bodies: and the triumph of my art is in thoroughly examining whether the thought which the mind of the young man brings forth is a false idol or a noble and true birth. And like the midwives, I am barren, and the reproach which is often made against me, that I ask questions of others and have not the wit to answer them myself, is very just-the reason is, that the god compels-me to be a midwife, but does not allow me to bring forth. And therefore I am not myself at all wise, nor have I anything to show which is the invention or birth of my own soul, but those who converse with me profit.

Plato (theaetacus dialog)

Socrates was famous for his Socratic method of teaching and this is Plato's recount of it. Socrates saw himself as a midwife, bring birth to new idea in the minds of his students, the seeds of which he claimed not to have planted:

Socrates: Some of them appear dull enough at first, but afterwards, as our acquaintance ripens, if the god is gracious to them, they all make astonishing progress; and this in the opinion of others as well as in their own. It is quite dear that they never learned anything from me; the many fine discoveries to which they cling are of their own making. But to me ... they owe their delivery.

I have never bought this idea of Socrates, namely, that all the teacher does is bring out what the student already knows by asking good questions. But, what clearly is true is that asking good questions is more important than supplying answers. A teacher's job is to help a student reason about things, and they can do that job best by being there at the right time to make a student think hard about what they are trying to do.

It is the mission of the pedagogue, not to make his pupils think, but to make them think right, and the more nearly his own mind pulsates with the great ebbs and flows of popular delusion and emotion, the more admirably he performs his function. He may be an ass, but that is surely no demerit in a man paid to make asses of his customers.

H.L. Mencken

The downfall of all teachers (I include myself here as well) is the assumption that there is right way of doing things, a right answer, a right point of view, and that their real job is to get the students to see it. Naturally, it is sometimes true that the teacher knows and the students does not. Two and two really is four. So, teachers can hardly avoid getting into the habit of setting themselves up as authorities on this or that and expecting students to learn what they are teaching. There is only one problem with this, it doesn't work.

It must be remembered that the purpose of education is not to fill the minds of students with facts... it is to teach them to think, if that is possible, and always to think for themselves.' --- Robert Hutchins

People who talk about education have forever been mouthing aphorisms about teaching students to think for themselves. It is the Holy Grail of teaching. Everyone believes it, but very few do much about it. Robert Hutchins was a radical in education. He transformed the University of Chicago. But he didn't eliminate grades and therefore he didn't eliminate the teacher as an authority figure whose views must be followed. As long as the teacher makes a judgement about the student, the student will try

to please him. It is simple human nature. Then, original thinking goes out the window.

"The authority of those who teach is often an obstacle to those who want to learn."

-- Cicero

This is not really an issue of grades, of course. The problem is deeper than that. Children are constantly being asked "how are you doing in school?" Supposedly, the askers of this question want to know if people who are supposed to be learning actually are learning. It seems a fair enough question. It seems like a quite reasonable question. But, it is one of the most seriously bothersome and difficult questions that our society asks. Inherent in the various forms of answers that we will accept to this question is the fundamental nature and design of what we think of as our system of education.

The question is problematic in a number of ways. The primary problem is with the basic assumption that educational achievement is measurable. As a society, we believe this in such a strong fashion, that is very difficult for anyone to disagree with it. Following on the heels of that issue, is the question of what the attempt to measure does to our system of education and to the way we teach. Third, and perhaps most important, is the problem caused by the idea that it is the role of our educational institutions to measure.

We want very badly to know that our investments in education are worthwhile. We want to spend our money wisely. We also want to know if students are learning anything. We need to know that they have been paying attention. We don't want to award degrees or certificates or licenses to those who were just faking it and are not really competent. All this makes a lot of sense. When you invest in production you expect a return on investment from the products you produce. And, this model would be just fine, if the product we produced in education were something other than graduates of the education system.

Factories produce finished products. The success of those products can be measured in any number of ways from judgments of quality to profits on each piece. But students are not finished products. In fact, finished

students are merely entrants on the highway of life. Their success is yet to be determined. They simply haven't begun the journey. If we measured the quality of an educational program by results, then the fair measure would be the results after the lives of the students were over. "Yale produces more millionaires than Podunk" would be a valuable measure if we agreed that money earned was the right arena in which to judge and if we could control for the earning potential of the students prior to entering Yale or Podunk. Such a measure would, of course, take too long to be of value and would be highly controversial in terms of deciding what the measures of a successful life might be. Podunk graduates might be happier than Yale graduates, if we could assess that and then we could decide on the relative value of these institutions based on our personal value systems.

But, alas, we are a society in need of speedy measures, so these issues will never be addressed. What we choose to substitute for the more lofty and impossible metrics is the issue. Basically we have two choices. Either we decide on a set of standards that measure the unfinished, untested, and soon to be released into the world student, or we don't. If we do, the question is *what measures?* If we don't choose to measure, then the question is: *what do we do?*

Of course, this choice has not been realistically considered. We all assume that there must be measures. Can we live without measures? If we cannot, how can we decide on a reasonable set of measures?

To legitimately address these two questions we must first contemplate the idea of measurement itself.

Every teacher's nightmare, and in some sense every parent's, and school system's, is that the student has gamed the system well enough to get a passing grade without doing the work. When a professor lectures, he knows that many students are sleeping, day dreaming, passing notes, and otherwise just occupying the physical space of the classroom without much caring about what is going on. Professors assign readings, grade homework, and administer tests to counter this state of affairs. "If they want to day dream, ok, but let's see how they do on the test!"

Tests exist in our system of education for a variety of reasons. They make the professors feel that something has been learned. They make

the school system feel that degrees are awarded to those who deserve them. They make parents feel that their child is doing well or that they can help my motivating them to do better. They assure parents that something worthwhile is going on when their children are in someone else's care.

In some sense, tests seem like a perfectly fine idea. If we attempt to teach somebody something, it seems a reasonable idea to find out if they know what they were taught. This idea is only a fine idea until one understands that there is a big difference between *knowing how* and *knowing that*.

The difference between these two notions of knowing is best illustrated by the test given to obtain a driver's license. All around the world, in every state and country that certifies drivers, there are two driver's tests. One tests if you can drive a car by having someone sit with you while you drive. The other is a multiple choice test that attempts to determine if you have memorized a set of rules about driving that the state would like you to know.

No matter what differences there may be in countries around the world, they agree on this: there shall be a *knowing how* and a *knowing that* part of the driver's test. No matter how huge the cultural and systemic differences in this world, unanimity on testing in this one circumstance. Amazing! Why is there such agreement one might wonder? Or to put this another way, how did it come to pass that the knowing how part actually made it onto the test?

In most other state certification exams, there is no knowing how part and in school there is almost never a knowing how part. So, why is this distinction preserved in driver's tests? How is it that there are two tests where nearly everywhere else there is only one?

The answer is easy enough to figure out. First, this stuff matters. We don't want our drivers to have only a theoretical knowledge of driving. We want to know if they can actually drive! Second, we know how to do it. We can administer this test. We know how to put somebody in the passenger seat and have them determine if someone can drive.

Now consider the same concept for a literature course. In the New York Times of November 30, 1998, there was an article about new English tests for fourth graders that has replaced some multiple choice questions with requests for students to write something of their own, analyze some literature, and so on. Not surprisingly, students and parents objected. They thought that this stuff was too hard for a fourth grader. Or to put this another way, testing “knowing how” is actually difficult, both for the student and for the administrator of the test. The motor vehicle department has to commit a great deal more manpower to the “knowing how” test than to the “knowing that” test. Multiple choice tests make everyone’s life easier -- except that you wouldn't want to fly on a plane piloted by someone who had never demonstrated to someone that they can actually fly the plane.

So, therein lies the rub. If we want accurate tests, we need to decide what is important to test. If we want scores that make everyone happy then we can take the easy way out. Unfortunately this is not the only issue. The question is bigger than testing. What should we be teaching? Is it possible that because we know that tests will be about knowing that kind of stuff, then we only teach knowing that kind of stuff? How does this decision affect what we transmit to students as education? Is it possible that tests cause us to throw out the baby with the bath water?

The formal name for tests of “knowing how” is performance tests. “Knowing that” tests are usually referred to as competence tests. Thus, there are three alternatives: performance tests, competence tests, and no tests. One can make the case for each.

But beyond that, there is another more serious issue. When one designs a course or a curriculum that really seems to teach what one wants to teach, it may be difficult to test it in any way and yet the no test answer may have no appeal.

To see what I mean here, let’s imagine testing a two year old child. We have spent two years raising this kid and now we want to see how he is doing. As alternative to this issue, as something to think about at the same time, imagine we have sent a kid to a one week summer course and we want to see what he learned in that course so we can decide whether we might want to send him again.

Now one obvious way to measure a two year old is to compare him to other two year olds along a set of dimensions that we care about. For example, we might consider verbal ability, physical coordination, social skills, potty training, and so on. Some of these are easy to measure -- potty training for example. Verbal abilities are easy to spot, but measurements can be unrevealing. For example, one could count the number of words that the kid says over a one week period. This number will vary widely from child to child. But how valuable is this measure?

For physical things, there are obvious tests. He could run a race and we could time him. We could ask him to carry a fragile object a certain distance and see if it arrives intact. Children will vary widely along these dimensions as well.

Social skills are harder to measure, but not impossible. Can the kid play with another kid for a certain amount of time without fighting? Can the kid negotiate with another kid for something he wants? Will the child do as instructed in a situation involving adults? Does the child need constant attention or can he play by himself? All of these are skills which can be measured.

But, these measures break down in a school setting. Suddenly there are subjects and curricula and their committees and Boards of Regents who want to know how everyone is doing. In corporations there are people whose job it is to determine how many people went through training and if the training time could be reduced without reduction in quality but no one is quite sure how to assess the quality in the first place.

All this has a profound effect on teachers. Teachers are part of the system of courses and tests and naturally they fall into the traps set by that system. As tests increase in importance in our society, teaching, in the sense that Socrates or Hutchins meant, becomes more and more difficult.

When I taught undergraduate courses at Yale and Northwestern, I tried to take myself out of the role of authority figure by eliminating grades altogether. I asked students to write about a subject I chose each week that had the property that there was no known answer so their answers could be interesting or not but they couldn't quite be right or wrong.

Then I refused to grade their answers. I simply noted whether they had tried hard or not.

This was a very difficult concept for students who were used to being graded at every turn and were very used to trying to satisfy the whims of the professor.

Here are some of the comments students made about this course the last year I taught it at Northwestern:

The professor was incredible.

Without doing too much work, you'll learn a lot about what you think and why you think it.

Wow. I never know such a great class could exist. I'm afraid that now, I will be disappointed by all of my other classes at Northwestern.

Take this class - Schank is great - it'll be the highlight of your semester.

This is the most interesting and provocative course I have ever taken.

Interesting class, but don't get fooled into believing you're learning.

Easy A, but the most boring, pointless lectures.

Don't take this class if you have any expectations to learn. My tuition was wasted by taking this class.

Students have a variety of expectations for what a course should contain and what it should accomplish. An entertaining professor may get high praise but he may be imparting very little. A professor who imparts a great deal of information in a dry way, may be formally fulfilling the criteria of the course but may leave the student knowing a lot less than the professor was trying to impart.

Being a good teacher means, in effect, fighting the system. And that system is enforced by everyone, including the students. Therefore, we need to give ammunition to teachers -- metrics by which they can know how they are doing and students can know if the teacher has succeeded and metrics by which the student can be judges that have some real import.

Ways to measure your own teaching

A teacher who is attempting to teach without inspiring the pupil with a desire to learn is hammering on a cold iron. - Horace Mann

1- A good teacher supplies motivation

Every student, in every course, has the expectation that what the teacher is trying to teach will somehow be relevant to his present or future life. It is obvious, if one takes this idea seriously, why so many courses in school fail to really work.

A student who is learning about long division, or reading Dickens, or studying ancient Greece, has questions in his mind about the relevance of what he is learning to his own life. Some students simply grant the school system the wisdom to know what is relevant and dive in. Others suspend disbelief long enough to pass the tests that will get them to wherever it is they think school will get them in life. For them, the relevance to their own lives is in the grades and they do what they are asked. For others, the belief in the system, and the quest for grades does not supply the necessary motivation and they lose interest and fail to learn what they are being taught.

The problem here is more than one of paying attention or worrying about whether students have a good attitude. The problem is deeper than that. Motivation is an integral part of memory. To put this another way, even if you accept that you will not fight the system and will try to learn whatever it is you were asked to learn, you may have a great deal of trouble remembering for the long term what you were not inherently

motivated to learn in the first place. You can't fool your memory into being motivated.

Memory is the name of the game here. The desire of any teacher is have the students come away having their memories permanently altered. Most courses cause a temporary memory alteration. In other words, students can pass the test and then have no ability to pass the same test, years, months, or even days later. College students report overwhelmingly that they could not pass the same tests that they passed a year earlier.

Now, compare this with exams that test whether someone can do a job that they already do. If that test is a good test, no studying should be required. Every employee who does his job well should know most of the answers to any reasonable question about his job. If he does not, then the test is bad. The reason for this is easy enough -- practice makes perfect. Memory for new information requires motivation to pay attention in the first place and practice in the use of that information in the second place.

Even if a student plays along when he is not intrinsically motivated and does well, it will be very difficult for that student to remember what he has learned. To remember something we must know where to put that thing in memory. If I tell you a random number you can keep it in mind for a short while, but after some time, you can't recall it, because it was meaningless, it didn't fit with any other information you had or any goals you were trying to achieve. If I tell you how to do something, how to do some operation on the computer for example, you will remember it as long as it takes you to do it and then, if you don't do that same operation for a while, you are likely to have to ask me for the same information again.

To really acquire new information one must recognize the need for that information. This is another way of saying that you must know where that new information will go in memory. Now, we don't know that sort of thing consciously, but we can know unconsciously what it is that we need to know. We know we don't need to know the date of the Battle of Waterloo, we know that we might need to be able to convince somebody of something in an argument. It is thus far easier to teach the latter than the former. If we should, for some reason, what to teach something that it is not inherently motivating to know then it is important to embed it

within something that is motivating to know. (The date might be the key to winning the argument for example although this begs the question of why anyone would want to teach the date in the first place.)

A good teacher supplies motivation or builds upon motivation that is inherently there in the first place. If the material to be taught has no inherently motivating reason to learn it built in so that any student would want to be in that course then the teacher must supply the motivation. No one has to explain to a student why they need to learn to drive or why they would want to know about sex, but one does have to explain why they need to know history. Since that explanation itself is still unlikely to supply the necessary motivation, it is incumbent upon the structure of the course itself to supply the motivation. That is, we cannot simply tell students why they should be motivated as this will not motivate them. We must build upon the motivation that a student naturally has and weave what we want to teach around it.

A successful teacher has the students in it clamoring for more. Students should be sorry the course is finished because they were so motivated to learn more. Measuring how motivated students are assesses both the teachers and a real student outcome.

The test and the use of man's education is that he finds pleasure in the exercise of his mind.

--Jacques Martin Barzun

2- A good teacher promotes and enables inquiry

When a child asks a question it is a wonderful thing. If they ask, it is usually because they want to know, and at least because they want to engage an adult in conversation. Conversation is, at its base, the root of learning. We learn in conversation because we have to play our role in the conversation. We have to keep up our end of the dialogue. This means that we must think of something to say in response to what we have heard. The process for doing that thinking requires that we analyze what we have heard sufficiently such that we can extract an index from it and match that index to something we already have stored in our memories. In other words, listening means matching what was said to what we know.

If what was said is mundane and already well known by us, then we match to an identity and say something like “right” or “I already knew that” or “that's what I thought.” When the match is partial, when we knew some of what we heard or found some accord with what we thought and some discord, or when we find something similar but not identical, then we have found something to say back. We can say what we were reminded of, or we can argue with a part with which we disagree.

This is the basis of dialogue, and dialogue eventually leads to the third possibility, that something someone says has no match at all in our memories. In such a case, we work hard at finding a place to put the new information. We need to store it someplace that relates to what we already know. So, we become curious, we attempt to understand better, so that we can fill in the holes in our knowledge and effectively relate what we heard to what we had known. This means we must inquire. Our part of the dialogue turns into questions at this point. We ask if what we heard really happened, we ask for explanations of what happened, we ask for facts that would make clear what we didn't know that confused us. To put this another way, when we are confused we can learn because we suddenly want to know. Without inquiry there is no learning.

It must be the goal of every teacher to cause students to begin to wonder about complex ideas. This is not simply an issue of having students ask questions -- since the desire to ask questions in a public forum is much more a matter of personality, perceptions of the teacher's receptivity to questions and to some extent, showing off. No, the real question is whether students are curious about the subject matter. A successful teacher causes the students to become interested in knowing more and to begin to find ways to get the information they seek.

3- A good teacher is surprising

It may seem odd that we expect that a teacher be surprising. But, if a teacher is not surprising, can there be any learning? We learn when what we expected to happen fails to happen. When things occur in life just the way we imagined they would, then we can say we already knew what would happen and there is little to learn from the experience. Knowledge

is, to a large extent, about predicting events. The rise of the sun in the east in the morning is a predictable event if you know about that subject. To those who have no rules about such matters, each sunrise could be a surprise. Knowledge is the opposite of surprise. If the sun failed to rise we would want to know what was going on. Failure of predictions based upon knowledge causes us to attempt to revise our knowledge base. We seek explanations from ourselves or from others, to help in our quest to make accurate predictions.

For this natural learning process, a teacher must surprise his students. But, more than that, a teacher must put students in a situation where they are entertaining predictions in the first place. We are not surprised if we aren't trying to understand and predict some events that are unfolding in front of us.

Lectures are rarely surprising, although they can be. If a good speaker sets up a situation which the listeners are following closely, then they can be surprised if events don't turn out the way they expected. Careful listening requires prediction. Comedians take advantage of this aspect of human understanding all the time:

“Last year we went on safari in Africa. We took pictures of the native girls but they weren't developed. We are going back next year.” Groucho Marx

Jokes like the one above count on the fact that a listener will have decided a particular sense of the word “developed” because of the context of “pictures.” This is the kind of prediction we are talking about. Violating it, in this instance, simply makes one laugh. In more serious venues, when one is trying to understand something more complex than a one-liner, a failure in comprehension of this sort, makes one think about what happened.

In order to create an active listener, one who is paying attention to what is being taught, one needs to make sure that there are many surprises that force many explanations. This is another way of saying that a student can't simply be listening or reading. They must be predicting as

well, and the teacher must make sure that the predictions the student makes are sometimes wrong so that thinking will begin.

But, the issue is more than simply making something think (or even laugh.) The issue of surprise relates to the material to be taught as well. Some subjects don't seem to lend themselves well to the idea of surprise. Is mathematics surprising? Certainly a good teacher can make it somewhat surprising by attending to those arenas in mathematics which are not obvious and predictable. But the problem is grander than that. Mathematics can be surprising in the sense that when one is trying to accomplish some task, what is needed to do that task may not be available to the student, The student may need to find something out because he may be surprised by his own lack of knowledge. This is a more important kind of surprise in a course. To put this another way, a student needs to be made aware of what he doesn't know and the surprise is finding out that he needs to know it in order to do something he wanted to do. The issue is prediction again. We can fail to accurately predict what tools we need to do a job, and thus be motivated to learn what we need to know. This kind of surprise is very important in any course of instruction. Without it knowledge is flat, unrelated to real world needs.

4- A good teacher causes structural changes to take place in the memory of students

All of the above has as its primary intention the formation of structural changes in memory. No person who enters a course of study unchanged by it has learned anything at all. Learning means structural change in memory. A student must change his beliefs, his point of view, his emotional stance towards a subject, as well as acquiring new knowledge. Knowledge is not acquired in a vacuum. Learning does not mean simply adding a set of facts to one's repertoire of knowledge. This inert view of knowledge is what underlies the current structure of courses in school. The idea is that people have a bank of knowledge and what a teacher does is simply add to it. Unfortunately it is not that easy.

What is actually the case is that people have attitudes, beliefs, procedures, and a range of other kinds of knowledge besides factual data. Learning means altering this less static type of knowledge as well. We

need not only to inform in a course, but also to create structural change in memory

People have complex memory structures that they use to help them understand the outside world and to be able to function in that world. They know how airplane trips work and use that knowledge to help them understand stories about such trips or use that knowledge to help them take a trip themselves. They understand how human interaction works and, here again, they use their knowledge to guide their comprehension and their functioning. The knowledge that they have changes daily. Each time there is another trip or another human interaction, there is the potential for change.

This kind of change happens through the use of memory structures that contain expectations about what will happen next. As these expectations prove to be wrong in some way, people change them, sometimes consciously and sometimes without realizing what they are doing. When a restaurant's food that was good is no longer good, we change our view of the restaurant. This is how natural everyday learning takes place.

For some reason, learning in school has always had a different set of underlying assumptions. We act as if being told about the restaurant's food will change our point of view, when, in fact, only eating will really cause a mental change to take effect. We learn very little by listening in the sense that what we learn can be repeated but does not become part of our processing apparatus. Memory changes when something causes it to change, when we experience something that makes us look at things a new way. A teacher must do this to be effective. No teacher that simply tells about the world will serve to change memory in any profound way. Memory change comes from actual experience. A good teacher must provide experiences.

Those experiences must be about something we care about (motivation), must cause us to become curious about them (inquiry), and must be unusual in some way (surprise) in order for memory change to take place.

5- A good teacher uses mental imagery to aid memory

The idea of “visual aids” has been with teachers for a long time. Teachers often show students pictures of what they are talking about. Lecturers frequently show interesting slides. Parents, when reading to children, know to let the child look at the picture at frequent intervals. We all know intuitively how important mental images are. When we try to recall something we often find ourselves picturing a scene or a face. We think about past events in terms of mental images and our memory is, in general, aided by them.

The pictures we recall best are, of course, those that satisfy the above four criteria. They relate to things we care about, are curious about, things that we find surprising, and things that cause us to view the world in a new way. There are, of course, other properties of mental images in addition to these four. Images can be pleasing because they are pretty or interesting or even repulsive.

When we consider how teachers use imagery, we need to bear in mind that the primary criteria we care about is memorability. If we are likely to remember the image then it is of some educational value potentially. There are other criteria, like relevance to what we are trying to teach for example. We can remember interesting sights, but what we remember about them must be germane. A good image should help us in doing, and that is the ultimate issue in memorability as well as in potential usefulness in a course.

6- A good teacher must incite emotional responses in the student

Emotions are the fundamental basis of memory. We remember what we care about. We dwell on what we are really upset about. We recall happy days and sad days. We get excited and we get depressed and we remember why. We remember being angry or hopeful. In short, we remember that which has caused us to feel something. Conversely, if we feel nothing, we remember little. A good teacher must evoke emotional reactions in its students.

Now this is easier said than done. How can mathematics be emotional? Well, of course it is for many students, usually negatively so. The issue

is to find a way to evoke emotional responses naturally. One such natural emotion can be found in the sense of accomplishment felt by someone who has worked hard to achieve a goal and achieved it. Students do sometimes feel this emotion, but usually that emotion is tied to a grade achieved or an exam that has been studied for and completed with success. The problem here is that what this means is that students are likely to recall the process of studying or the emotional reaction of getting the good grade and neither of these relate to recalling the content of the course itself.

The issue for teachers is to get the emotionality to be tied to the content in some way. What this can mean in practice actually boils down to one of two things: either a powerful demonstration or a powerful reaction to doing -- the frustrations associated with doing and the sense of accomplishment associated with achieving one's goal.

Put into practice, this means that in the telling model of education, memory alteration can be achieved and thus learning will take place, to the extent that the story being told or images being shown are emotionally powerful. One might expect that one could learn about the Holocaust for example, by seeing vivid pictures or hearing first hand stories. Even without doing one could learn if the emotional impact was high.

But, in a doing environment what this means that one has to feel emotions associated with the doing. If it were possible one could easily teach about the Holocaust by making students experience some of the same experiences. This would probably best be done in simulation given the rules of education under which we live, but from a memory point of view if you want students to remember, the more real it is the more easier it would be to remember.

7- A good teacher encourages practice in doing

Doing is what learning is all about. We learn so that we can do. Everything in education tends to point the other way. the idea behind most schooling is that we learn so that we can know. But knowing without doing is a

rather meaningless state of affairs. Not all doing is physical of course. Mental doing or social doing are also kinds of doing. Learning to do means learning procedures and practicing those procedures.

Most of school leaves doing out. Most courses are a kind of preparation for a doing that never take place. Sometimes, arguing about ideas, a kind of doing, does occur in a course. Sometimes laboratory work in a course allows some practice in doing. But, in a standard lecture course, there usually is no doing at all.

A good teacher must not only encourage doing but he must make sure that all his teaching is centered around doing. The teacher should be about preparing students to do something, having them do it, and then having them reflect upon how well they did it and prepare to try again.

8- A good teacher encourages practice in reasoning

I have saved this for last because this is the most important. In the end, all education is about is teaching people to reason. If reasoning were a subject per se, then you could teach people to do it and they would be forever capable of reasoning. Unfortunately, reasoning in physics isn't exactly the same as reasoning in political science, although they do have some things in common. To learn how to reason in our daily lives we must practice reasoning in task specific situations. Reasoning on the job is the most important part of learning a job. It is easy to learn procedures, it is much harder to learn what to do when those procedures fail or when there are no rules that fit the situation. Being able to handle new issues that come up is the hallmark of intelligence.

Thus, it is the job of every teacher to help students figure things out for themselves. Yes, there are rules. Yes, there are ways of doing things. Yes, there are facts and cases and examples to be followed. But most of all there is figuring out what to do on one's own. Learning really means preparing oneself to go out into the world and practice what one has learned to do and this means doing it without help.

Mentoring

A good teacher is a good mentor. They don't teach anybody anything. They help as needed. Teaching is a bad idea. Mentoring is a noble idea. You really can't teach anybody anything they don't want help in doing.

The best way to mentor anybody is to let them loose and only say something when asked. The key issue in mentoring is when to tell. The question for a mentor in a learn by doing course is simple: at what point should the mentor tell the students how to do it?

In learn by listening courses, the answer is: **all the time**. We might be tempted to say therefore, that in learn by doing courses the answer is: **never**. This isn't quite the case however, so what we have written here are the exceptions to "never." That is, there are times to tell students something. We are sure the list of when when to tell is too long. When in doubt, don't tell anybody anything.

Rule #1: **Be ignorant**

When asked, a good mentor claims ignorance. Your favorite response to a student question should be: *I really don't know. What do you think?*

Rule # 2: **Live and let live**

It is important to realize that not every student is suited for every role. In a well designed story centered curriculum, there will be many roles to play and every student will have different talents. It is not necessary, as it is in traditional courses, that every student have the same level of achievement. Some students will never get it about something. That is ok. It is important to let students move on, when they are stuck. It is important to let students work harder at one thing than another because they are better at it or more interested in it. A good mentor recognizes when a student can be unstuck and lets him live if he can't be unstuck.

Rule #3: **Know when to tell and when to run like hell**

3a: You can tell a student the answer when the answer is a small missing fact that the student would have to spend inordinate amounts of time attempting to figure out on his own.

3b: You can tell a student the answer when his following the wrong course of action might lead to danger or a recovery period that is way too long given the situation.

3c: Don't tell the student anything if you know he can figure it out on his own.

3d: Don't tell the students anything if the reason he does not know the answer is basic laziness of thought or deed.

3e: Don't tell the student anything if what he needs to know has been written down somewhere and that writing is accessible.

3f: don't ever tell the student an answer when the performance objective of the exercise is the discovery of that answer.

Rule #4: **What do you suggest?**

Suggestions are good. In fact, the real role of a mentor is to make suggestions. Of course, there are suggestions and there are suggestions. When suggestions look like the gospel they are bad. When they are presented as something to think about, they are good.

4a: When a student is misdirected and needs re-pointing, it is good time to make suggestion. If the student is headed south when he should be headed north, it might just take him a 1000 miles to realize his mistake. The 1000 mile journey is mostly a waste of time. After 10 miles it might be a good idea if the weather seems to be getting warmer.

4b: When the information a student needs has been discovered and somehow the student hasn't realized it. This is a good time to ask them if they would recognize their own nose if it were in front of them.

4c: When the student is spinning his wheels and accomplishing nothing. Putting him on a solid footing and letting him start driving is a good idea when he is so stuck he will never get out on his own. A mentor needs to recognize when this is the case. This is, in the essence of the art of mentoring.

Rule #5: **Let it lie**

This might seem like an odd idea: Lie to your students. We don't mean by this telling the exact opposite of the truth in a factual situation. But, there are times when a student has an idea and that the key issue is to get them to express that idea, understand its ramifications, play with the idea a bit. This will never happen if your response to an idea is to expand upon it yourself or even simply to ask a student more questions about the idea. It is a better strategy to deny what the student has said by adopting what seems to him to be a patently absurd stance. Typically students get emotional in such a situation and get fired up in an attempt to show you what a dope you are. They work hard to come up with reasoned argument. You should work just as hard to show why they are wrong. It doesn't matter whether they are wrong or not. Say things you don't believe if it will advance the cause of the students thinking harder about how to defeat you. It is not your job to show the student how smart you are nor to earn the students respect for your good ideas. It is much better to make the student think hard.

Rule #6: I want to hold your hand

Holding a student's hand while they attempt to do something can be very tempting. While we like the Socratic method as a means of mentoring, Socrates, in the slave boy dialogue at least, was not actually being a Socratic mentor. It is possible to hold the hand of the student too much, to have them follow your lead and seem to understand, only to find out that when left to their own devices they cannot do it on their own. Don't put words in the students mouth and don't hold the hand that is doing the actual work.

6a: Generic strategies are worth telling to students (at the right time.) Hand holding with generalities is more useful than hand holding with specifics. "Now turn the wrench another quarter inch" is exactly what not to say.

6b: Specifics that are about practice on the other hand can be suggested. Reminding a kid learning to hit a baseball to keep his elbow up is one of those things that you cannot say too often. It is easy to fail to do because you don't realize that you are not doing it and it has to become second nature. Helping a student get something to become second nature is what hand holding is all about when done correctly.

Rule #7: One more time, this time with feeling

Practice is the essence of doing correctly. Understanding when a student has gotten it right and when they have simply happened to have succeeded is critical in mentoring. Good mentors know when more practice is needed. Good mentors also know when the rest of what is to be done can be skipped because the student got it faster than expected.

7a: Make the student do it one more time when the student believes they've finished but they can do better.

7b: Let them stop when feedback on the current attempt would make success trivial and tedious.

Rule #8: Stop in the name of love

A good mentor knows when a student needs to be diverted from frustration. Often this means simply telling the students to stop doing something and do it later or having the student do some other problem instead. Also, as stated in rule #2, sometimes this means simply letting the student realize that the problems he is working on is simply not his future career and letting him bag it altogether.