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# Just Scoring Points

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More than 30 years of teaching biology at a large state university has led me to an unsettling conclusion: Professors and students are laboring under very different metaphors for education, and neither group is particularly conscious of that fact.

Let me illustrate my point with a story. I often try to make my students aware that metaphors, though commonly used to help us understand the unfamiliar, can also limit or distort that understanding. Last semester I was discussing metaphors for education, and I asked the students in my course on insect biology whether they thought various ones were apt.

Almost unanimously, the students rejected my comparison of education to the teacher's pouring knowledge into empty vessels. I then proposed a different metaphor: constructing a building — adding facts and concepts like one brick after another, to create an edifice of understanding in which each element is connected

to others.

“Is that a good metaphor for education?” I asked. The students generally felt that it was.

“Those of you who believe that you labor under this metaphor,” I said, “please raise your hand.” All the students raised their hands.

“Now, this is very interesting,” I said, smiling. “You do understand that to build an edifice, every brick you add must remain in place? That is, in your education, you have to remember what you learned before, so that you can build on it in the next phase of education. But we have repeatedly experienced here that you remember little from your previous courses — or, for that matter, from the previous test, or even from last week. Your behavior violates the basic requirement of this metaphor.”

Some students nodded their understanding; others looked poleaxed.

“My observations suggest that there is another metaphor that describes your mode of operation more closely,” I said, “and that is sports. When you play a sport, your preparation reaches a crescendo just before a match (exam). If you win the match (exam), you get points (grades) in proportion to your placement. You keep track of those points, strategizing about how to get more next time. The match leaves no residue other than the points. At the end of college, you enter the working world with your overall standing (grade-point average) and little more. Your approach is certainly effective in getting the points that get you through college, but it is poor when it comes to getting an actual education.”

None of the students argued with my interpretation.

Admittedly, the sports metaphor is not perfect, but it does explain why students transfer so little knowledge from one course to the next. The vast majority of students who have learned about levers in basic science courses in middle school, high school, and college cannot recall how a lever works when they study insect biology with me. The same goes for energy metabolism, or why the earth experiences seasons, or what a protein or carbohydrate is.

And even though most students remember individual factoids, they can hardly ever give a coherent account of anything broader. The identity of and relationship among component pieces elude them.

We faculty members love to bemoan students' lack of understanding, and it is tempting to place all the blame on them. Yet in light of how we teach and test them, the sports approach may actually be an intelligent and effective strategy for them to use.

Each professor focuses on a limited subject and assumes that previous courses have placed the foundations securely in students' minds. We rarely demand or even encourage long-term memory or cross-disciplinary thinking. We focus on the latest, red-hot discovery because that is what interests us, and we are blind to the fact that most students don't have a firm foundation to their edifice of knowledge — at best, they possess a jumbled pile of bricks.

Just as in sports, students game the system. That is why they hound professors with the question, "Is this going to be on the test?" In other words, will it possibly add

any points to my tally? When they discuss their exams with us, they almost always focus on grades. Increased knowledge is not their goal.

That fact became clear to me when I saw that most of my students did not know, and did not really want to learn, the meaning of important concepts like homology — the idea, basic to biology, that corresponding structures of related creatures can evolve to be quite different, like the bat's wing and the human's hand. I conducted an experiment on students' learning, twice in introductory biology courses with 250 students each, and twice in smaller courses on insect biology, with 20 students each. First I defined and explained homology. In the next lecture, I gave an unannounced quiz that asked them to define it and give examples. Only about 25 percent of the students in the introductory course answered correctly.

I gave the answers again, emphasizing their importance. In the next class meeting, I gave students the identical quiz again; about 35 percent could define homology and give examples. When I gave the same quiz a third time, a week later, about 60 percent of the students managed to answer more or less correctly. Finally, I put the question on the final exam, and still only about 60 percent got it right. In my more-advanced course on insect biology, everybody finally learned the material at the fourth iteration of the quiz.

That lack of effort to learn a concept in a timely fashion is surely more compatible with the sports metaphor, which would focus on the low number of points students could get on the quiz, than with the edifice metaphor.

Every once in a while, I meet a student who does treat education like building, who remembers and can apply material learned in previous courses. It is a stunning

difference from the behavior of most students. The vast majority of Americans (including most government officials) probably believe that students with higher grades take more knowledge away from a course. Yet because most students operate under the sports metaphor, that belief is only an illusion — except possibly for the periods immediately before and after exams.

Why do students behave the way they do? Perhaps because our educational system unrelentingly rewards them for their performances on tests. Perhaps because they generally are not interested in the world around them, but feel they need college degrees to get decent jobs. Perhaps because the sports metaphor dominates so much of American life.

It really doesn't matter much. What is important is the behavior's consequence: From an educational standpoint, rather than an economic one, college is a waste of time for most students, and teaching is a waste of effort for most professors. It is a waste of national resources on a colossal and increasing scale.

The students flooding into most state universities are increasingly being subsidized by tax revenues. In my state of Florida, the great majority of students get a free ride through the Bright Futures Scholarship Program. They have to pay for room and board, but they would have to do that whether or not they were in college. All they have to do to keep the free ride going is to win enough matches (pass enough exams) to place (receive a sufficient grade) at the end of the season (semester).

What is to be done? To begin with, don't expect me, a hard-working professor in the trenches, to be able to work miracles. I insist on more long-term learning and more integration across subjects than my students face in most of their other courses. But

I am only one person fighting a social phenomenon that is national in scope and many years in the making.

However, there are steps that universities could take to begin changing students' learning metaphors. One is to recognize that the lecture format evolved to serve students who are highly motivated to learn; it is excellent for them, but the average student gets little out of lectures. What could economically replace them in the auditoriums at large state universities is not clear. But whatever it is, it needs to engage students as active participants, or they will not learn.

A second step is to replace multiple-choice exams, now used by almost every professor, with essays. Sure, it takes much more work to grade essays, let alone to give constructive feedback on them, but that is one of the few ways to find out what students really know. It is also an important way to improve their writing, which often is truly pitiful.

A third is to increase the integration of the curriculum. Each course should reinforce, at a higher level, the foundation that students ought to have acquired earlier and should demonstrate how the material from previous courses is relevant in the new context. The Romans had a saying that rings true: Repetition is the mother of learning.

I now see seniors majoring in biology who do not know how natural selection works or what issues are involved in global climate change. And few students can explain such subjects clearly. Only when students become truly competent at explaining their chosen specialties in speech and in writing can we consider that we have succeeded in educating them.

My recent attempts to change my students' educational metaphors have given me hope that it can be done, but it is not easy. I now give a short quiz at the beginning of every class. I also call on every student more than once in each lecture and ask him or her to explain some point to the class, using complete sentences. If the student doesn't know the material, I explain it and how it fits into the current lecture.

The atmosphere is friendly, and the students like talking to their peers; absences have been close to zero. But, of course, I cover less material than I would in a traditional lecture. It is really more like teaching high school than like teaching college, but that is what is needed at large state universities today.

I recently gave my students an unannounced repeated test, and I was gratified that all but one student improved, and a few improved greatly. They are beginning to see that the sports metaphor may get them a degree, but it won't get them an education. And they now know that there is another way, and they can choose to take it.

Truly educating our students would require serious reforms and a great deal of coherent effort by a lot of people. But in the interests of duty and self-respect, we had better get to work.

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