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IEEE AP-S Education On Line: www.ece.utah.edu/~cfurse/APS

The IEEE AP-S Education Committee is establishing an online resource for EM Education. This will include lists of course notes, labs, software, etc., available online or through the mail, online tutorials, etc. If you would like to have your course or other materials included in our online resource (and highlighted in the *Magazine*), please send the URL and a paragraph (or more) describing the materials by e-mail to cfurse@ece.utah.edu.

List of Topics:

Courses
- Basic Electromagnetics
- Antennas
- Computational Electromagnetics
- Microwave Engineering
- Advanced EM
- Electromagnetic Compatibility
- Wireless Communication
- Others?

Hardware Labs and Demonstrations

Software Labs, Visualizations, and Demonstrations

Tutorials

IEEE AP-S Undergraduate Scholarship Recipients

The IEEE AP-S Undergraduate Scholarship recipients for spring, 2003, are as follows:

Ju-Ling Eng
Ohio State University; Advisor: Dr. Fernando Lisboa.

Teixeira Said Hassan Said Islam
American University of Sharjah (AUS). Advisor: Dr. Nasser Qaddoumi.

Additional scholarships will be given in November. Details are available at http://www.ece.utah.edu/~cfurse/APS.

Teaching and Learning Combined (TLC)

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Most professors have to learn a LOT. Every day, it seems, there is something that we need that we don't know. So what do you do to learn this new information? Perhaps you hit the Web or the library, find a tutorial, a textbook, or a paper, and give it a little reading time in between a 12:00 class and a 2:00 meeting. But you still don't quite "get it." No wonder, by the next day, most people only remember 10% of what they *read*. Of your precious hour, you received six useable minutes.

So, you stop a colleague in the hall, or catch someone by phone, and engage them in *discussion*. Now you understand, you think, how great to have colleagues to help out. Yes, your hour in the hall probably did you a great deal of good. Most people remember 50% of what they learn through discussion with others. You gained 30 minutes of learning.

Now it is time for the proof of the pudding, and you sit down to *do* the derivation/measurement/simulation/application that you set out to do in the first place. Of course, you thought you had it figured out, but there were a few details that you had to struggle through, until you finally got it right! You have confidence and a pretty thorough understanding, now that you have been able to

practice your new knowledge by doing it. In fact, you probably remember 75% of what you learned during your hour in the lab, 45 minutes of good solid understanding.

Finally, you are ready for tomorrow's *lecture*! You prepare an hour's worth of exciting and stimulating lecture notes, showing all of the new information you have acquired. And it goes great. The students act interested and engaged (at least for the first 20 minutes, the average adult attention span), someone asks a good question that makes you puzzle over your derivation a little, and you complete your learning process.... No wonder you seem so intelligent to your students! You will remember 90% of what you teach today. They will retain a mere 5% (three minutes) of your well-thought-out lecture.

It is time that we rethink the tried and true (or tried and troublesome) methods that we have been using to teach engineering for decades. The almighty lecture didn't work any better when we were in school. How many lectures do you remember, versus the cool demonstrations in your physics lab, the late nights doing homework with your study group, and the time you "TAed" the class and had to really figure it all out? So why do we persist in doing the same thing today? It is illogical to give the same input to a system and expect a different output. We complain that there is not enough time to teach everything we want to teach, yet we are willing to tolerate students forgetting 95% of what we teach them in our well-meaning lectures.

David A. Sousa (*How the Brain Learns*, Reston, VA, The National Association of Secondary School Principals, 1995, ISBN 0-88210-301-6; Corwin Press, 2000; ISBN: 0761977643) summarized the average adult retention rate after 24 hours with his Learning Pyramid. It is reproduced here (Figure 1), in the upside down fashion that we teach today. If you remember only 10% of what you read in this month's column, please remember that *most people remember 90% of what they teach to others*. And then take every opportunity to let students teach each other.

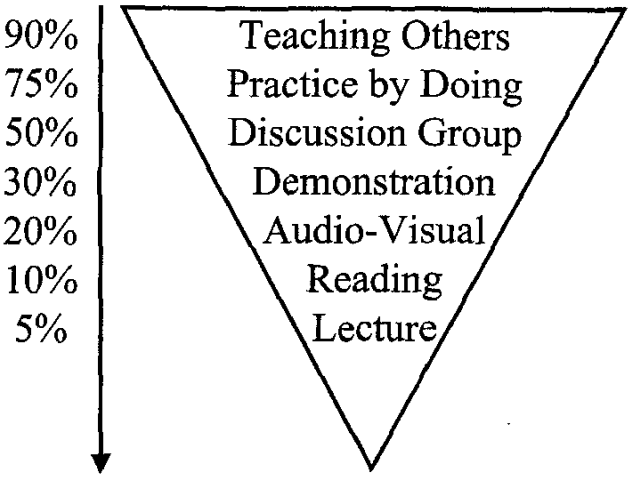

Figure 1. The Learning Pyramid, adapted from David Sousa, *How the Brain Learns*, Reston, VA, The National Association of Secondary School Principals, 1995, ISBN 0-88210-301-6.

Here is a Possible Class Format

- Expect students to read the text before coming to class (10% retention), and encourage them to come early to compare homework answers before class (by coming early yourself, to provide "free" answers to homework questions...it's easy, and it sure frees up your office hours!)
- Hand out a one-page summary of the material for the day, including a step-by-step method for analyzing or doing the problems you want the students to be able to accomplish, and an example that follows that step-by-step process.
- Give a 15-20 minute lecture (5% retention) that includes a visualization (20% retention), and a quick demonstration (30% retention) of how to apply the step-by-step process (or something cool from the lab).
- Spend the next 15-20 minutes with the students in small groups. Give them a new example to solve, and have them practice how to do the solution (75% retention) in discussion (50% retention) with their group. Do the example in parallel on the board, so that you can answer questions as they arise.
- Spend the next 20 minutes with each student looking over a different problem on the homework, "setting it up" for the others, and "teaching" the others how to do it (90% retention).

And Some Extra Teaching Activities You Can Add to Your Class

- Occasionally, hand out an interesting article or news clip, and ask different groups of students to review different aspects of the article, or perhaps even different articles. At the beginning of class, gather students into groups, and have them explain their section to their peers.
- Add breadth, oral, and written communication (ABET-friendly activities) to your class by having each student choose an application of the material you are studying, write a short tutorial on it, and do a 10- or 15-minute presentation at the end of the semester. If you have a large class, have a symposium where students present in parallel, require each student to visit a certain number of symposium presentations, and also invite the other students in the department. You will probably be surprised at the level of student interest, especially when their friends are doing the teaching. ☺
- In the lab, have different groups of students become proficient on specific lab equipment or software tools, and have them be responsible for teaching that information to the rest of their group.

So, give Teaching and Learning Combined (TLC) a try. TLC is how we professors learn, so it makes sense that our students can learn that way, too!