“MAKE YOUR CLASSROOM A COMMUNITY THAT EQUIPS EACH INDIVIDUAL FOR SUCCESS”

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Adult Learning (Androgogy) Techniques for Medical Physics:
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First, a required disclosure slide:

Disclosure

- Employee of Accuray Incorporated
IN THIS TALK ARE IDEAS FROM PREVIOUS MENTORS:

- Homework ideas are from Rock Mackie (Medical Physics Professor).

- Term paper ideas are from Ray Fonck (Nuclear Engineering Professor).

- Symposium ideas are from Robert Jeraj (Medical Physics Professor).

- Lecture ideas are from Speech Instructor as an undergraduate at Penn State.

- Exam ideas are from Rock Mackie and Mike Van Lysel (both Medical Physics Professors)

I tried to combine all the best ideas from my past when I took over Medical Physics 501 from Rock Mackie at the University of Wisconsin – Madison.
1. Make group problem solving tasks that are fun and accepting of risk taking. Have at least one social event to help teams to form. Laugh at your own mistakes, and make it easy for students to speak up. Encourage them to teach each other: peer-to-peer teaching is highly effective.

2. Spend some time with individual students and smaller groups, at their level. Do some homeworks with them, as one of them, to see what the roadblocks really are. Some students need some things done differently, so make that happen.
3. Make exams deep and varied with high quality, time consuming grading. Students always appreciate more detail and care in grading, helps them up-their-game too. Make projects that directly train them for something practical as well as teach content.

4. Make lectures a detailed story with frequent references to key concepts, mixed with fun extras. It is 100% the teacher’s job to make it an interesting lecture. Optimize total motivation = teacher motivation * student motivation.

5. A bit more ... some dos and don’ts
1. THE WAY I ACCOMPLISH COMMUNITY FOR RESEARCH SKILLS:

a. Students do a group project, learning useful writing and speaking skills for graduate school:
   -- they write it up as a journal article;
   -- they write a typical AAPM style talk and present it like a small conference to each other.

b. I have them form groups in a party! I call it a ‘donut mixer!’

My students learn to write in real world styles:

By the way, I teach TG-21 in my theoretically focused class to connect cavity theory to REAL protocols.
2. STUDENTS PLAY AN ACTIVE ROLE IN HOMEWORK REVIEW, ALSO CREATING COMMUNITY:

I am not doing a fad here, but there are elements of it!

a. They present a problem to the whole class: It develops public speaking skills, learning to solve a problem in front of others. I request all students be polite as they are critical.

b. Then, they correct other students’ homeworks! (not grading, just indicating what is right and wrong.

c. There are elements of this that connect to “flipped classrooms” or “peer learning” BUT, What I am doing with homework was inherited from Rock Mackie who got the idea from his old professor in Canada. So, not a new fashion, but actually an established technique!
3. MY EXAMS ...

a. Stay away from multiple choice as a main part of the exam. Make the exam creative for a variety of people.

b. Hand back exams with histograms on the front:

![Histograms of exam questions]

c. I try not to curve the grade: I try to keep scale fixed and adjust the difficulty to get one or two 100% scores but try not to get scores lower than 50%.

d. Take extra care in grading: students always welcome your careful effort in grading!
4. LECTURES

a. Provide details and examples. Using power point for lectures is not a good idea: often too thin on info.

b. Do examples frequently BUT they are time-consuming, so not too many.

c. Tell them a story! Make it entertaining.

d. Be very open to questions and student feedback: they are customers!

e. Make a coherent and organized set of notes that point to textbooks.

From my notes:

**Charged Particle Interactions with Matter:**

- We will switch gears now that we know about *transferring energy to charged particles* – let’s find out what happens next – how do these charged particles then deliver the energy to matter as they slow down.
- We will start with an important derivation that will then be generalized to eventually work for electrons slowing down in condensed matter.
- As familiar from what we covered earlier, a *heavy charged particle with kinetic energy* $T$, velocity $v$, with a lot of inertia going very quickly by an atom with an impact parameter $a$:

\[ M_i \quad v \quad b \quad R_{in} \]

- The "heavy and fast" particle at the base of the arrow in the above figure has a charge, $Z_i$, and a mass, $M_i$, and a significant energy, $Mc^2$, such that $v=\sqrt{\frac{T}{M}}$ ("fast approximation"). The bound electron on the other hand has only a charge, $-e$, a mass, $m_e$, and bound energy such that kinetic energy $T$, roughly equals its potential energy. The velocity is $v$ (not frequency here). In other words, $m_e v^2/2 = e V(\approx 0/137)$, the fine structure constant, $\alpha$, squared. Therefore,

\[ V^2 = e^2/\hbar^2 \approx 0/137 \], the fine structure constant, $\alpha$, squared. Therefore.

I send old & original papers:

14. Dr. N. Bohr: *Theory of Decrease of Velocity of the Orbits* gives

\[ \sin^2 S = \frac{1}{1 + \frac{p^2 v^2}{e^2 E^2 (M+m)^2}} \]

where $2\theta$ is the angle through which the direction of the relative motion is deflected by the collision. For the sake of brevity we shall in the following use the notation

\[ \lambda = \frac{eE(M+m)}{V^2 m M} \]

The velocity of the electron after the collision will make
IN FACT, I MADE MY LECTURES INTO A SMALL / CONDENSED BOOK FOR THOSE TOO BUSY TO TAKE A CLASS OR READ A HUGE TEXTBOOK:

A lot of people in your adult class may be just interested in practical knowledge, so

make sure you get to the point quickly when you can, after that, go into theory and detail

-- lots of summary charts
-- lots of good diagrams
-- some examples with correct units and significant digits
DOS AND DON’TS:

1. Never publically embarrass a student: that is never really forgiven.

2. Never say you know something if you really don’t: the bigger the class, the more it gets noticed, but

3. Always remember that students always forgive honest mistakes, if you are graceful about it.
CONCLUSION:

INFORMATION IS RETAINED WHEN ATTACHED TO EMOTIONS OR SOMETHING UNEXPECTED/INTERESTING:

MAKE YOUR CLASS MEMORABLE!

*People will forget what you said. People will forget what you did. But people will never forget how you made them feel.*

-- Maya Angelou