

Random Thoughts . . .

MEET YOUR STUDENTS

3. Michelle, Rob, and Art

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The scene is the AIChE student chapter lounge at a large southeastern university. Three juniors—Michelle, Rob, and Art—are studying for the second quiz in the introductory transport course. Art got the high grade in the class on the first quiz, Michelle was close behind him, and Rob got 15 points below class average. They've been at it for over an hour.



Michelle: "What about this stuff on non-Newtonian flow—I don't think I really get it."

Art: "I think we can forget it—I've got copies of Snavely's tests for the last five years and he's never asked about it."

M: "Maybe, but it's the real stuff...you want to analyze blood flow, for instance, Newtonian won't work."

A: "So what...the only blood flow we're going to have to worry about is ours on this test if we don't stick to the stuff Snavely is going to ask."

M: "Yeah, but if we don't..."

Rob: "Hey Art, is there going to be any of that Navier-Stokes trash on the quiz?"

A: "Yeah, there usually is, but no derivations—you just have to know how to simplify the equation."

R: "Rats—I hate that garbage."

M: "I've been looking through Bird, Stewart, and Lightfoot...there are all sorts of Navier-Stokes problems in there. We could try to set some of them up."

R: "Nah, too much grind—I just need to do enough to get my C, my degree, and my MG. Art my man, why don't you haul out those old tests and let's just memorize the solutions."

A: "Okay, but that may not...hey, look at this question—he's used it for three years in a row. Parts (a) and (b) are just plug-and-chug, but he throws a real curve ball here in Part (c)—I don't know how to do it."

R: "How much is Part (c) worth?"

M: "Never mind that—let me see it.. Okay, he's asking about velocity profile development—you just need to use the correlation for entrance length."

A: "What are you talking about? I never heard of that stuff."

M: "He never talked about it in class but it's in the reading. You need to calculate the Reynolds number and then substitute it in this dimensionless correlation, and that gives you..."

R: "I'm gonna grab a Coke from the machine, guys—when you get it all straight, just tell me what formula I plug into, okay?"

A: "Yeah, sure. So it's just this correlation, huh Michelle—do I need to dig into where it comes from?"

M: "Probably not for the test, but I was trying to think why you would want to know the entrance length, and it seems to me that if you're designing a piping system that has a lot of short pipe segments it would be important to know how well your pressure drop formulas will work...blood flow again, in capillaries, or maybe lubricating oil in a car engine, or..."

A: "Forget it—that stuff's not going to be on this test. Even Snavely wouldn't be that tricky. Now look at this problem here..."



These three students illustrate what Entwistle [1] calls *orientations to studying*. Michelle has a *meaning orientation*, Rob a *reproducing orientation*, and Art an *achieving orientation*. The characteristics of the orientations are as follows:

Meaning Orientation *Michelle tends to take a deep approach to learning, meaning that she tries not just to learn facts but to understand what they mean, how they are related, and what they have to do with her experience. Meaning-oriented learners are characterized by an intrinsic motivation to learn ("I want to learn this material because it interests me and I find it relevant to my life") and a tendency to question conclusions offered in lectures and readings.*

Reproducing Orientation *Rob almost always takes a surface approach to learning—following routine solution procedures but not trying to understand where they come from, memorizing facts but not trying to fit them into a coherent body of knowledge. Reproducing learners are characterized by an extrinsic motivation to learn ("I've got to learn this to pass the course, to graduate, to get a good job") and an unquestioning acceptance of everything in the book and in lectures. They often do poorly in school.*

Achieving Orientation *Art's primary goal is to get the highest grade in the class, whatever it takes. Achieving learners take a strategic approach to learning, which involves finding out what the instructor wants and delivering it—digging deep when they have to, staying superficial when they can get away with it.*

Sooner or later most faculty bull sessions lapse into complaints that most of our students are Robs and pitifully few are Michelles. Unfortunately, few of us do anything in class to stimulate our students to take a deep approach: we just give them tricky tests to see if they can "do more than plug in," and then gripe that they're apathetic and incompetent when they can't. Fortunately, there's something we can do besides complain. The following conditions in a class have been shown to increase the likelihood that students will adopt a deep approach to learning [1,2]:

- **Student-perceived relevance of the subject matter.** *Students will not struggle to achieve a deep understanding of material that seems pointless to them, any more than we would. To motivate them to do it, let them know up front what the material has to do with their everyday lives (e.g., fluid flow in their cars and circulatory systems, heat and mass transfer and reaction in the atmosphere and their homes and respiratory and digestive systems) and with significant problems they will eventually be called on to solve (e.g.,*

fabricating improved semiconductors, developing alternative energy sources, avoiding future Bhopals).

- **Clearly stated instructional objectives, practice, and feedback.** *Students are not born knowing how to analyze deeply, and little in their precollege experience is likely to have fostered that ability. To get them to pull meaning out of lecture material and to solve problems that go beyond those in the text, spell out these objectives and give concrete examples of the kind of reasoning desired. Then explicitly ask the students to carry out deep analysis in class and on homework and give them constructive feedback on their attempts.*
- **Appropriate tests.** *Provided the preceding conditions have been met, include questions that call for deep analysis on all tests. If the students know they will only get surface questions (closed-ended exercises that require only standard solution procedures) they will likely take a surface approach to learning the material. If they expect some deep questions (more open-ended questions that require greater understanding), all of the Michelles, most of the Arts, and perhaps some of the Robs will see a need to take a deep approach and do so.*
- **Reasonable workload.** *If students have to spend all their time and energy just keeping up, they will fall back on a surface approach.*
- **Choice over learning tasks.** *Provide bonus problems and/or optional projects, and/or alternatives to quizzes, and/or optional self-paced study, and/or choices between group and individual efforts.*

The research indicates that by establishing these conditions we may substantially increase the number of our students who think critically about the material we are presenting, try to discover its meaning and its relationship with other material they have previously learned, and routinely question the inferences and conclusions that we present in class. Whether or not we'll know what to do with these people once we have them is a question for another occasion.

REFERENCES

1. Entwistle, N., "Motivational Factors in Students' Approaches to Learning," in R.R. Schmeck, Ed., *Learning Strategies and Learning Styles*, Plenum Press, New York, Chap. 2 (1988)
2. Ramsden, P., "Context and Strategy: Situational Influences on Learning," in R.R. Schmeck, Ed., *op. cit.*, Chap. 7 □