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Three Common Demands from Students in Large Classes and What to Do About Them

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I recently had a conversation with a faculty member about the midterm feedback she had received from the students in her course. Her response to their suggestions echoed one I often hear in my work in faculty development: "Really, I can't believe all the things students want me to do for them nowadays—they expect to be spoon-fed. This isn't grade school!" As faculty we can indeed feel beset by student demands today. No wonder—the students attending our colleges and universities come from more diverse backgrounds than ever before, and they may be more focused on attaining credentials for a job than expanding their minds.

But not all of our students' demands are unwarranted. Sometimes our students are expressing the needs and frustrations of novice learners in our fields. They know that something isn't working for them, but they may not know the real basis for their problems nor the best way to fix them. In these cases, we need to translate their comments into the language of learning (Hodges and Stanton 2007). Only then can we decide whether—and how—to change our

teaching to accommodate an apparent student need.

As I look at the midterm feedback I have gathered for years from a variety of large lecture classes, I see some common themes. The themes across these courses reflect the needs of novice learners in our disciplines and connect to what the research says about how learning works. Below I list three common student requests and ways to think about responding to them.

Students Want the Presentation Slides

In large lecture classes in which the faculty member uses presentation slides, the students overwhelmingly want the slides, preferably before class. Many students have been raised on PowerPoint since grade school, and their note-taking ability is often underdeveloped. Add in the content-heavy nature of many of our disciplines, and students can easily feel overwhelmed with information. But it isn't our jobs to compensate for students' lack of prior training, is it? And if we provide the slides, won't students simply disengage?

The process and value of taking notes may not be as simple as either our students or we think. Mueller and Oppenheimer's study (2014) on the effect of students taking notes with a laptop versus by hand suggests that simply transcribing

notes verbatim via laptop isn't that effective in promoting conceptual learning. In the study, students who took handwritten notes took fewer notes but performed better when tested than students who took notes using a laptop—even when both groups had time to study their notes. This finding was especially true of student performance on conceptual versus factual questions. The real power of taking notes may be in the mental processing we do as we generate them. Theories of learning propose that for complex content to be transferred to long-term memory we must first focus our attention on it and then connect it to prior knowledge retrieved from long-term memory. When taking notes, for example, students often need to evaluate an idea's relevance or weigh its importance. Unfortunately, the number of ideas that we can focus on at once, our working memory capacity, is *very* limited. In a fast-paced lecture, new incoming information readily displaces the old from our working memory before it can be linked to prior knowledge in a meaningful way. This shortcoming can handicap students' abilities to take useful notes, especially when students have not heard or read about the ideas we present beforehand.

Cue Up Prior Knowledge. One solution that scaffolds students' note-taking skills is to use, and provide students with, skeletal slides. If our slides primarily provide an outline and important images or data, then students must focus their attention to fill in the gaps. At the same time, however, the outline helps them cue up former knowledge and organize new ideas. In addition, we can aid their novice note-taking skills by repeating key themes and by pausing frequently to allow them to catch up—or, better yet, provide an activity that deliberately engages them in processing information. Emphasizing main points and drawing clear connections between ideas is not pandering to students' demands—it's recognizing

the cognitive needs of new learners in our fields.

But will students stop coming to class if we provide the slides ahead of time? Research results on this question are mixed. But if the class session consists of purposeful activities that fill in critical gaps in the information presented on slides, savvy students will still come.

Students Want Practice Tests

Many of us provide our students with organized content, our goals for their learning, and examples in class. So when our students ask for practice tests we may feel that they really are going too far. Wouldn't that be giving it away?

Not really. The brains of novices aren't wired like ours. Our expert's brain includes packaged "chunks" of both interrelated information and tools to process it that our novice students lack. Their knowledge tends to be more compartmentalized and less connected. Thus, students often struggle to see the forest for the trees in terms of our disciplinary content. For instance, physics students frequently classify problems as being about pulleys or incline planes rather than about forces and friction (Chi, Feltovich, and Glaser 1981).

Similarly, our students are usually more facile at acquiring information and less adept in applying and synthesizing concepts. And, indeed, in classes that are content heavy, the content overload itself tends to push students into rote learning rather than learning for understanding (Prosser and Trigwell 1999). Thus, focusing students' thinking both in class and out on applying and integrating ideas is key to their developing expertise. A good test shows students not only what we expect them to know, but also how we want them to use that knowledge. Providing practice exams, then, gives students the opportunity of training their brains to make the kind of mental maneuvers that we expect of them. In addition, the act of taking a test helps promote, not just assess, learning

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Editor's Note:

What do students want? And what should we give them? What do we think they need? Surely questions like these trouble faculty minds. And where do faculty turn for answers? Sometimes the best answers may be hidden in plain sight. **Linda Hodges** takes that position in this issue of the *FORUM*. Student evaluations often call for one thing which really represents another. They want to see practice tests, for example; we see them as focused only on grades when we want them to focus on learning. But maybe it's also true that they're just novice learners looking for a better map to new territory.

Linda Hodges concludes her piece mentioning the value of pre- and post-tests, a topic **Linda Verdone** and **Rebecca Maas** explore in detail in their contribution to this issue. Verdone and Maas have worked out a clever way of combining these proven pedagogical tools with some group work so that the process balances individual responsibility and class participation. It breaks down the isolation of learning, invoking the best from the individual as well as the classroom society in the service of learning.

In classrooms like the ones that evolve from approaches like those of Verdone and Maas, a natural, healthy openness about learning evolves. It could almost be described as a kind of public metacognition or at least open contemplation. Indeed, making classroom experiences contemplative may be a vital step in increasing the environment for better, deeper learning. **Elaine Yuen** who teaches at Naropa University has done a lot of thinking about creating contemplative classrooms. Indeed, at Naropa (a Buddhist inspired institution) the idea of contemplation is not only *not* new, it's central. To faculty used to seeing students plop down and open their phones, the idea of beginning class with a quiet pause, a bow of the head from faculty to students and students to faculty might seem other-worldly; yet, in so many other contexts we continue to practice small ritual gestures acknowledging a higher purpose. All rise when a judge enters a court room for example. At Naropa the "Naropa Bow" both symbolizes and actualizes this atmosphere of respect for the higher purpose of learning. Perhaps a bow isn't a very transplantable ritual, but other aspects Yuen discusses are. One in particular seems to me to have long been part of the best teaching—deep listening. Over and over through the years of observing the best teachers I have been impressed—indeed humbled—to see them respond to what I found myself impatiently regarding as "dumb questions" with thoughtful responses that made these occasions into genuine teachable moments.

And a last point in Yuen's piece on "mind" and having the textbook "come alive" fully describes the energy and focus of **Michael Pravica's** piece on teaching physics. I had the pleasure of observing one of Mike's classes during *NTLF's* residency at UNLV in 2014; so, I've seen this 'coming alive' teaching first-hand. Readers will, I think, be struck by the way he teaches the value of "approximation" to his students. It gets past the high hurdle of "right answers" to the energy and learning in "good answers."

Coincidentally, **Ed Nuhfer's DEVELOPER'S DIARY** this time offers a resource rich exploration of the overlap between contemplation and metacognition. Thinking about thinking and worrying with a problem aren't at all the same.

Oh and what about all those valuable after thoughts you've had about how to teach the course better next time? **Marilla Svinicki's AD REM** . . . offers some good counsel on what to do with those.

And so a new semester begins. Good luck to us all.

— James Rhem

through the so-called testing effect (for example, see Karpicke and Roediger 2008).

Have Them Write A Question. Just providing practice exams for students, however, can be misleading. Students can revert to the naïve notion that learning is memorizing and simply memorize the items on the test. We can illustrate the purpose and value of test-taking by using old exam questions as group exercises in class. Such activities engage students in analyzing and synthesizing ideas and promote their metacognitive abilities as they discuss options and rationales. If we then extend the exercise by asking students to create a new question that probes understanding of the same concept, we are encouraging them to think like an expert. Rewiring the brain is hard work, and providing practice exams is one way to help.

Some Students Want Active Learning, Others Want More "Teaching"

In classes taught primarily through lecture, students often want more interaction in class. In classes taught predominantly through active learning methods, however, students are often divided—some like it and others don't. Students may complain that faculty aren't "teaching" when they use these approaches. Should we risk getting poor evaluations by lecturing more? Or should we abandon lecture and hope for the best?

Research evidence strongly supports the value of active learning in promoting student learning (Freeman et al. 2014); so, adopting or refining our use of these approaches is well worth the effort. Student resistance to active learning can stem from students' lack of familiarity with the format, lack of comfort in working in groups, or lack of trust in us (Seidel and Tanner 2013). In addition, if students believe that learning equals memorizing, they will see no value in listening to anyone but us. Because we hold the keys to their grades, they can be afraid that what they do in

groups won't match what we "want" on exams. Students can also be telling us, however, that they need more structure or guidance in how to learn from these formats.

Hold Up A Mirror: Pre-Post Test.

Effective active learning requires us to be intentional and methodical in cultivating the learning we want for students—otherwise it can be, both in appearance and actuality, no more than busywork. We need to make sure that the purpose and value of each activity is clear and that students receive feedback on their efforts. Active learning can appear chaotic, and students may not know just what they learned from it. Capturing key ideas on the board (or screen) or having students summarize main points can make learning explicit. Doing a short pre-test before a session followed by a post-test at the end can also dramatically demonstrate learning gains.

If we are good at lecturing, however, then doing anything else well may take some practice and temporarily affect our student ratings. Gathering and acting upon students' midterm feedback whenever we try something new can circumvent any unpleasant surprises on our end-of-term evaluations.

The Value of Student Demands

The bottom line is that our students' demands provide a glimpse into their challenges and fears as novice learners. Responding thoughtfully and humanely to student voices can make the classroom experience more meaningful and enjoyable for both our students and for us. |||

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INNOVATIONS

Motivating Students to Pre-read and Participate through Pre/Post Quizzing

Melinda Verdone, Midwestern University and Rebecca Maas, Rock Valley College

Research has shown the benefits of previewing a text prior to being exposed to its information in class; students can better connect the new information to prior knowledge and arrive in class with a basic understanding of the material. Additionally, they are more prepared to ask questions and participate in discussions (Heiner, Banet, and Weiman 2014). However, fewer than 30% of students read their textbooks prior to coming to class

(Burchfield and Sappington 2000). So, why don't students do the assigned reading? Typically, students have very full schedules, so they spend the most time on activities that produce the biggest payoff. Students don't see the utility of reading material prior to class—there usually aren't points to be earned by pre-reading (at least not directly), and students know that the material will be explained to them in class. Moreover, many students struggle to read the assigned material. Some might not have the necessary reading skills to understand the content, and they may not have been explicitly taught how to read an academic text effectively.

The Setup

Baldwin (1980) found that pre-quizzes motivated students to prepare for class lecture and discussion, extended the time period over which material was studied, and revealed areas of improvement to students prior to an exam. This instructional strategy can be extended to include a post-quiz to encourage class preparedness and capitalize on peer-learning. With this approach, students take individual responsibility for pre-reading their textbook and are enabled to assist others who struggle with the content. Several benefits of collaborative quizzing have been uncovered, such as the promotion of discussion and anxiety reduction (Weimer 2016).

Baiting The Hook

To implement this strategy, students are first assigned reading material prior to lecture. This material is carefully chosen to be relevant and engaging, and at an appropriate level for the course being taught. If necessary, teachers should model how to read the text, pointing out prominent features to facilitate learning. Students then take a pre-quiz based on the assigned reading. This pre-quiz is taken individually online through a learning management system or other online software. Quiz questions are application-based to eliminate students simply scanning

for bold words in the text. Students must read the material, think about it, and decide how it applies to what is being asked. Students are given their overall quiz score, but specific feedback identifying which questions were missed is not shared at this point. An additional benefit to an online quiz format is that results can be used to guide instruction, allowing teachers to emphasize concepts that students struggled with most.

Fishing

Next, lecture and in-class activities take place, presenting the material and clearing up any misconceptions students may have.

Afterwards, students retake the same quiz, this time in class within small groups. Each group must answer the quiz questions collaboratively and provide explanations for their answers. This explanation requirement scaffolds active discussion among group members and opportunities for peer-learning. It is important to establish a culture of group participation starting with the first class and to keep the same groups throughout the course in order to maintain a positive group dynamic. After collection of the post-quizzes, answers are reviewed so that students are provided immediate feedback on their performance.

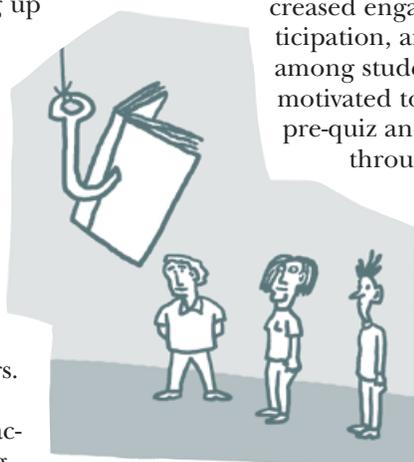
Landing The Learning

Finally, pre- and post-quiz scores are averaged to produce a single, consolidated quiz grade. This grading approach necessitates individual responsibility for the reading material, yet promotes in-class participation. For example, if a student does not attempt the individual pre-quiz, they may still participate in the post-quiz in class. Upon averaging of the scores, the maximum grade that could be earned in this

situation is 50%, which is an F but still better than no points. Group participation is encouraged by the fact that taking a post-quiz could only drive their average quiz score up—students are not penalized if their post-quiz score is lower than their individual pre-quiz score. Furthermore, if the post-quiz (with the prospect of raising their individual quiz score) is presented as an extra credit opportunity, students are highly-motivated to participate.

Benefits Abounding

In our classes, we have seen this pre/post-quiz strategy result in increased engagement, class participation, and peer-learning among students. Students are motivated to do well on their pre-quiz and therefore read through their assigned materials more regularly. Group participation brings accountability to students who may not otherwise actively engage in discussing the material with their peers, and



the post-quiz strategy provides a framework for student discussion to take place within those groups. Since earning extra points on the collaborative post-quiz requires students to come to a consensus on the correct answer and to explain their choice, this justification fosters dialogue among students and promotes critical thinking about the material. Students, especially when not initially agreeing on an answer, engage their classmates and debate answer choices instead of simply guessing.

Increased class participation has been evident as well. Students, having reviewed the information and been quizzed on it prior to attending class, are more likely to ask questions relating to the material during class. Using feedback from frequently-missed pre-quiz questions prior to class allows the lecture to be tailored to cover those

concepts more carefully, as well as allowing the instructor to ask questions during class discussions to assess if student understanding of those concepts has improved. This teaching method allows for multiple opportunities for peer-learning to occur. The collaborative requirement of the post-quiz enables students who grasp the material to assist those who are struggling, and the instructor is able to monitor and listen in on peer-to-peer discussions as students consult with one another for clarification of the concepts within their group.

The pre/post-quiz strategy is a powerful approach. Pre-quizzing motivates students to come to class better prepared to participate and ask meaningful questions, while the collaborative nature of the post-quiz promotes student engagement and critical thinking. When combined, the result is a richer in-class experience with active student participation and meaningful feedback. |||

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Creating a Contemplative Classroom

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The other day, a colleague asked me how to create a contemplative classroom? As faculty at Naropa University, a “Buddhist-inspired” university, the quality and practice of contemplation and meditation pervades all of our classes on campus. So, what might we consider “contemplative”? As the Contemplative Mind in Society has illustrated on their website (<http://www.contemplativemind.org/practices/tree>), there are a host of practices that could be considered contemplative, which include meditation, yoga, prayer. Indeed, the image of a tree evokes a fruition or blossoming of a joining of personal somatic awareness and conscious thoughtfulness.

Contemplative practice doesn’t always mean mindfulness meditation—although contemplative practices are often deeply rooted in tradition, history, and extensive personal application. In this essay, I’m not going to talk about the many different contemplative practices, as this has been well documented and there are an ever expanding array of different modalities (ref tree of contemplative practices). What I’d like to explore is how the learning environment—a.k.a. the classroom—is created through mutual experiences of one’s body, speech, and mind. I’m basing my observations on what I teach my Master of Divinity students in our Contemplative Communication class. We use the framework of “basic attendance,” first taught within the Contemplative Psychology program at Naropa, to

explore facets of contemplative communication (Trungpa 1982).

The Bow

Classes begin with a pause, and end with a pause. So it is with Naropa University’s contemplative classrooms. The pause, often embodied in the “Naropa bow” (<http://www.naropa.edu/the-naropa-experience/contemplative-practice/the-bow.php>) establishes a brief moment of not-doing and not-knowing—a rarity in our contemporary Western world. It gives one an opportunity to stop in the midst of our rush to achieve, get ahead, and move on to the next thing.

Yet the beginning and end do not predicate what flows in between—the classroom content. Whether the topic is meditation practice and theory, eco-psychology, or research methodology—classroom content emerges from the joining of academic expertise with the pause of not-knowing. Faculty bring to their classrooms a commitment to an academic discipline, often acquired and honed in traditional Western academic settings, as well as an openness and curiosity informed by their personal contemplative practices.

Body:

Personal and Environmental. Body refers not only to one’s physical body, but also to the physical environment(s) of the classroom. There is a natural interplay in how our experience is contextualized by the cultural, environmental, and social setting(s) that are not only found within the classroom walls, but equally what is found “outside” of those walls. Observations of the “environmen-

tal body” may inquire: What is in the classroom? And how are the seats and students and teachers arranged to evoke a contemplative atmosphere? Is it indoors or outdoors? What time of day is it, and what is the weather outside? Observations of the more personal body might include: What stances do the instructors as well as the students take? Are students slumped over? Sitting in a circle? Does the instructor sit behind a desk, or stand up while others are sitting?

The physical and physiological relational structures that are established in a learning setting naturally predicate the flavor of communication that takes place within the classroom. At Naropa, instructors may elect to arrange the class in a circle, with the instructor an

“equal” participant within that arrangement. Or, instructors may prefer the more traditional seat behind a table or desk, with students arranged in rows or in two semi-circles.

Speech:

Verbal and Energetic. The arranging of these personal and environmental aspects of “body” helps to determine the quality and tone of communication that takes place within a learning environment. By speech we not only are referring to the literal words that are spoken, but also their quality and how the act of speaking might (or might not) evoke a mindful and contemplative quality. In general, it refers to the energetic quality that is evoked by the interplay of instructor, students, and material. This does not imply that all discussion taking place within a classroom should have a uniform quality. A



classroom with a mindful flavor of discussion might have aspects of genuine listening, a give and take, as well as an authenticity of expression. Mindful speech has been presented as six points which include: listening to one's own speech, listening to the speech of others, slowing down speech, enunciating clearly, simplicity or choosing words well, and including silence as part of speech. (Rockwell 2012)

Speech includes a "gap" or "fresh start"—which infuses class sessions at Naropa. This brief moment allows for the instructor, as well as the students, to momentarily let go of concerns and busyness that we all bring along with us, results of an increasingly inter-connected and electronically stimulated society. At the inception of the class sessions at Naropa, and at the end, a brief silence, a bow, marks a mutual willingness to let go, even for a moment, the cares and discussion we might bring to the classroom. It allows for a "fresh start" to the topic of discussion at hand—establishing a space that could hold a heated discussion on climate change as well as a measured analysis of Buddhist texts.

Mind:

What is Taught and What is Experienced. Mind refers to what is most commonly understood as the content that is presented through lectures, books, homework, and so forth. In the contemplative classroom, the "content" also includes one's personal experience, how the words or images on the textbook page may "come alive" within the landscape of one's own experience. While the more concrete and traditional content is often rooted in what may be read, heard, and written about, an inner understanding that may arise from the contemplative classroom includes the students' and instructors' genuine emotional and somatic connection to the material.

One challenge is to be able to balance the contemplative qual-

ity (which often brings a sense of spaciousness) with the sharpness and precision of content. Ultimately, any learning should be relevant, timely, supported by contemplation and reflection, but also be able to face argument. A reflective aspect within a classroom may give psychological and cognitive space to digest and consider content. Students are encouraged to both demonstrate knowledge imparted from readings as well as personalization that comes from contemplation and personal investigation of the material (Ray 2004).

Balance and Paradox

There is a natural tension between the content orientation of the "left brain," and a more intuitive understanding evoked by "right brain" contemplative modalities. These aspects of classroom learning are both important, and may require management of their paradoxical perspectives, rather than coming from one or the other alone (Johnson 2014). Each approach has potentially enriching and limiting qualities, and one role of the instructor is to steer classroom learning between these two polarities.

For instance, a contemplative classroom may be more spacious, and allow for the "unpacking" of emotions that often reside below the surface. However, too much space may not contextualize the learning harvested from this unpacking, and result in unclear learning objectives. Conversely, a classroom which emphasizes didactic learning regarding emotions may emphasize theories, but limit a more individualized, personal understanding. In Buddhist learning environments, these two aspects are seen as two wings of a bird, both necessary for flight.

In conclusion, participation in the contemplative classroom, either as instructor or student, requires the balancing of these perspectives. The qualitative aspects of what creates a contem-

plative classroom may be experienced through the domains of body, speech, and mind. And, the pause—evoked by a brief bow, allows one to briefly step into the liminal, unknown space, where the kernel of possibility lies. Any classroom is a learning community. To infuse the classroom with a contemplative sensibility supports a more deeply experienced and personal understanding for all participants. ■■■

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The *Forum* encourages submissions on any aspect of college teaching and learning. The ideal article falls within a 1,500 word limit and, following Thomas Sprat's praise of the Royal Society, holds to a style of writing that reflects a "close, naked, natural way of speaking."

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ESSAY

“Why do I need to take physics?”

Michael Pravica
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As a physics professor (with over 20 years of instructional experience) who often teaches introductory physics to premedical students and other non-physics majors, I have developed a number of strategies to get my students motivated and excited about physics. Physics, as the foundation of science, is critical for so many fields of human endeavor. Furthermore, in a day and age when we are so heavily dependent on technology, our nation needs critical thinkers who can solve problems associated with this technology and understand how to garner useful information *that makes physical sense* in a world full of myriad data (often garnered via a computer or other electronic devices) and associated units. Physics offers a “ground up” perspective of our universe where there is no such thing as a “black box.” Thus, mastering physics gives our students more confidence, awareness, and the ability to solve the “real world” problems they will encounter in the future.

Living Physics

On the first day of class, I always explain to my students that they may not understand why they are required to take (and pass) physics for their chosen major, but those who pass WILL understand

this “*why*” by the semester’s end. I also explain to them that they are “doing” physics every moment of their existence, whether in using their optical detectors (their eyes) to sense photons (visible light), utilizing their auditory sensors (their ears) to listen to my lecture, generating sound waves via vocal chords, walking to class (balancing their body about their center of mass by neutralizing net torque and action/reaction in propelling themselves forward), and of course processing everything that their senses take in via electrical signals that are flying around their brain (the most amazing computer that we know of). Thus, my aim as their physics professor is to merely make them aware of what they do instinctively all the time!

Measuring Physics or “Units”

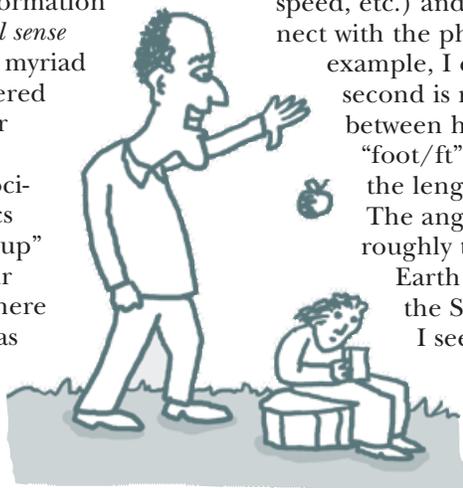
Throughout the semester, I also introduce and emphasize units along with new concepts. Units define measurable quantities (time distance, mass, energy, resistance, speed, etc.) and enable us to connect with the physical world. For example, I explain that the second is roughly the time between heart beats. The “foot/ft” may have been the length of a King’s foot. The angular degree is roughly the angle that the Earth subtends around the Sun in a day. Thus, I seek to demystify the concept of units by relating them to everyday ideas that help the students realize how

units enable connection with our physical world. I also explain that every day, people die or are severely injured because someone didn’t understand units. I delve into the Metric system and discuss the logic of having everything based on factors of ten (number of fingers on two hands)—kilograms, hectograms, dekagrams, grams, decigrams, etc.—and stress the

importance of becoming comfortable with understanding and working with units. I ask the students if they would want to understand the difference between a picogram of cyanide and a milligram of the same if their lives depended on it? I mention examples where planes crashed because of misunderstandings of the British Imperial gallon of jet fuel, the liter, and the American gallon. I discuss an example where a multi-million dollar space probe crashed because of using “g” (the acceleration of gravity at the surface of the Earth) in British units (32 ft/sec²) instead of in Metric units (9.8 m/s²). Thus, in a data-driven world, it is crucial to understand the myriad units which are a consequence not only of the empirical basis of science but history and culture.

Showing Demonstrations

Whenever possible, I use demonstrations to explain physics concepts such as waves, sound, optics, magnetism, and many other physics principles. As a picture is worth one thousand words, so is a demonstration worth one thousand blackboard explanations. Over the years, I’ve developed a number of successful demonstrations which the students mention how much they learned from and appreciated in their course evaluations. As one example, I use an oscilloscope, waveform generator, speaker, tuning forks, and violin in combination to demonstrate the physics of sound. This also helps them make the connection between mathematical sine waves, vibrations, energy conversion, and sound. At the demonstration’s end, I typically play an assortment of pieces (e.g., “The Star Spangled Banner,” “Hava Nagila,” “Miserlou,” and “Tamo Delko”) to show the students that beautiful physics “makes” beautiful music (sound waves). No second semester introductory physics course would be complete without a Tesla coil demonstration to help explain concepts of the inductive/capacitive (LC) circuit, transform-



ers, electromagnetic energy, and the radio. Of course this demonstration also introduces students to the inventor of this coil, Nikola Tesla, who is largely considered to be the father of the radio and our alternating current electrical grid.

Solving Problems

Along with visual means to aid learning, I solve problems (some of which

I spontaneously create in class) in each lecture on the board—step by step. I dislike using calculators (especially with the high probability of pressing the wrong keys *vis a vis* “Doc, the calculator gave me this ‘answer’ so it must be right”),

and I try to wean my students off them as they are often used as a crutch. I encourage students to critically examine their answers to determine if they are sensible. For example, on problems that ask students to estimate the number of water molecules in the ocean, a “calculated answer” of 1.8×10^{-18} is illogical (<1) but students will write this down without even thinking about the meaning of the answer they obtained. That’s just not physics. I also worry about how many people in the real world use the “answers” provided to them by a machine without thinking about whether or not the answers make sense. How many catastrophes (e.g. bridge/building collapses) in our society were caused because of silly calculation mistakes?

Approximation and Thinking

When obtaining the answer to a problem, the process is made easier by liberal rounding/approximations. Thus, as I work

out problems on the board—step by step—and, I typically round off numbers (e.g. $\pi^2 \approx 10$) and, with the amazing and trivial computational power available via scientific notation (powers of 10), I can obtain the answer to a problem faster via approximation (within at least 3% accuracy) compared to my students who will often use their calculators (sometimes I

challenge them to a race).

Also, as I may momentarily forget some formulas and dislike looking them up in our textbook, I often derive equations (which I liken to “concepts”) repeatedly. Thus, I discuss the concept of the “lazy physicist” and

how we would rather calculate in our head, on a napkin, or on the sand (if we happened to be on a deserted island). Math is our language and a tool to express and manipulate physical concepts such as acceleration (rate of change of velocity) or torque (rotational force). Science cannot be mastered without proficiency in math.

Sleeves Up

During lectures, it is absolutely necessary that I engage the students with questions. The “stupid” questions that students fear to ask may generate a Nobel prize (as in the past). Thus, I seek to create a positive learning environment where students feel comfortable querying me (i.e., no question is “stupid.”) I also seek to augment discussion with as many “real world” examples of physics as possible. This includes sharing my stories of times when I’ve been asked to share my physics knowledge outside the lab and classroom. There was the random phone call



I received from a technician at a famous Boston hospital needing help in using an EEG machine, and the time when, ten minutes before class, I was asked to perform a quick pressure/pump calculation for a contractor building UNLV’s Dental School (e.g.).

One measure of an effective teacher is his/her ability to “sense” the understanding of students in real time. To aid in this effort, I give weekly quizzes usually based on the most recently covered chapter. The quizzes are considered to be the bare minimum of what I consider critical to pass the material contained in the chapter and are designed to be easy, requiring only 10–15 minutes. The problems are written to be easily calculable with little need for a calculator. After collecting the students’ quizzes, I immediately discuss the solutions while the quiz problems are still fresh in the students’ minds. The graded quizzes are returned (with generous “red ink” feedback) by the next lecture. The students have told me that they appreciate the quizzes for the rapid feedback and quick check on their conceptual understanding, and also as a good study guide for the midterm and final exams.

With these efforts to engage, motivate and train my students to be analytical problem solvers, I find that by the end of the semester, they largely “get it.” They understand how critically important physics is to their life, career, and society. Some years after they graduate (even after some eventually become doctors), some tell me how much they appreciated my efforts to get them to master reality. My mission is accomplished! |||

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DEVELOPER'S DIARY

Mindfulness as a Metacognitive Skill:

Educating in Fractal Patterns XLVII

Ed Nuhfer

Professor of Geology, Director of Faculty Development and Director of Educational Assessment, California State Universities (retired)

Executive Editor James Rhem introduced “contemplative pedagogy” to *NTLF* readers in 2012 (*NTLFV21N3* & 4), and interest in it has since grown rapidly. The recent article by Karen Costa in *Inside Higher Education* <https://www.insidehighered.com/advice/2016/08/09/stress-management-can-help-more-students-succeed-college-essay> highlighted how ideally contemplative pedagogy meets the needs of today’s stressed-out college students.

While “pedagogy” focuses on teaching, mindfulness focuses on knowing. Mindfulness develops by the learner from within. It is not a pedagogy. Further, the ineffable nature of mindfulness does not lend itself to assessment through tools like rubrics or concept inventories that are revered in the established assessment of student learning. Because mindfulness offers a way of being and knowing, it is a metacognitive skill that transcends all disciplines and even applies to all of life.

What is Mindfulness?

Writers frequently describe mindfulness with phrases such as “...being in the moment” or “being fully engaged in what we are doing at a given time.” The meanings of these phrases are foggy but become clearer after considering what happens in the absence of mindfulness.

Without mindfulness, we operate in what some call “default mode.”

In default mode, we drain attention from what we are doing by having a background dialog with ourselves, daydreaming, playing music in our heads, carrying on imaginary conversations, worrying, perhaps deprecating ourselves for some perceived shortcoming, or getting upset with reactivity for no good reason. As examples of operating in default mode, suppose we engage in a discussion of an important issue with a colleague. Our mind darts to a point that we want to make in the conversation, and we are already framing a “response” to a colleague while she or he is making a point that we never really heard. We are simply not “being in the moment” to truly hear our colleague.

Consider the number of faculty committee meetings you’ve experienced in which PhDs filled the room, operated in default mode, and all engaged to be heard and to convince others. If you have recently attended a faculty committee meeting, try to recall what you heard there. Many readers will recall hearing what they said but little of what others said. Gaining mindfulness can change such hapless experiences.

Another example of acting without mindfulness lies in “multitasking.” Institutions’ seeking “efficiency” through several decades of striving to “do more with less” have not improved conditions for educating, but they have produced cultures of overwork, lack of empathy and expectations for multitasking, which encourage the opposite of mindful professional practice. When multitasking, we never fully engage with any person or task. The brain operates in an unfocused frenzy in vain efforts to engage with several issues at once. While we might believe that some act of

will or training can bring success, it cannot, because multitasking is a myth and has no basis in science. It is not a learnable skill. Human brains cannot engage with two tasks simultaneously, much less several tasks. Mindfulness brings an understanding of “fully engaged.” It also permits an understanding of why one should neither attempt to do multitasking nor have expectations that others should either.

How Does One Develop Mindfulness?

The most basic training to develop mindfulness is a very simple meditation practice. One chooses something easy to concentrate on, such as feeling one’s breath during sitting calmly or feeling one’s feet connecting with the earth as one walks. One works for ten to twenty minutes daily on maintaining the connection of the mind to the chosen place. During this time, the mind will slip into default mode. The practice involves noticing that the break from focus happens and then responding by consciously bringing the mind back to the chosen area of concentration. Such observations are metacognitive reflections —“thinking about thinking”—that bring awareness of how one is operating.

Achieving unerring concentration is not the objective of mindfulness training. Rather, observing oneself making the breaks and developing healthy compassion by accepting those imperfections in self are the objectives. With repetition, practitioners develop a greater capacity for keeping the mind consciously engaged when needed and more skillfully “living in the moment.”

In “Contemplative Pedagogy Part 1” (*NTLFV21N3*, p2–3) James Rhem mentions the practice of Amherst’s Joel Upton whose students consider one painting of their

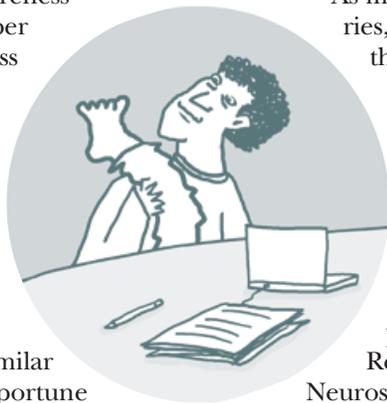


choice for the entire term to experience the “threshold of beholding.” There, Upton’s students go beyond seeing the painting as an external object. A similar mindfulness exercise during a walk is to stop, close the eyes, and then to open them to observe the scene before us for about a minute as an artist’s painting. This brings awareness of the infinite number of “paintings” we pass by on every walk but never really see. We can then sense our being within the “painting,” not apart from it as an observer. After doing that a few times, try doing a similar exercise at some opportune time in one of your classes. See your class and those in it as a momentary “painting” and feel your presence as a part of it. I hope your first experience is as memorable as mine. I will never forget the feeling of enjoyment and the felt privilege of being there in that moment.

While developing the deep sense of self-awareness sought by devoted Zen practitioners can take many years and intense practices, cultivating the mindfulness needed to make measurable improvements in learning and everyday life can occur in as little as six weeks (<http://www.news.ucsb.edu/2016/016572/change-bundle>). Training over a few weeks even has lasting effects (<http://dx.doi.org/10.1080/17439760.2010.508883>) and professional practice done mindfully registers measurable improvements (<http://www.ncbi.nlm.nih.gov/pubmed/24019273>).

Meditation?—Seriously?!

Just four years ago, our editor James Rhem warned: “To skeptical ears ‘contemplative pedagogy’ may sound like the latest franchiseable insight into better teaching, something new perhaps” (*NTLFV21N3*, p1). Indeed “meditation” still invites patronizing comments such as “navel-gazing” or “Om-om-om!” Many will



confuse mindfulness meditation with an imagined form of mystic religious practice, which it is not. For skeptical academics accustomed to viewing education as an acquisition of disciplinary knowledge and skills, accepting mindfulness as a way to improve academic performance is not easy.

As mentioned in past Diaries, influential skeptics in the behavioral sciences managed to repress the validity of both affect and metacognition for decades. Today, however, the availability of brain imaging makes the exercise of unwarranted hubris particularly dangerous. Recent sources like “The Neuroscience of Learning and Development” (Ludvik, M. J. B. 2016. Sterling, VA: Stylus) devote many pages to the documented connections between mindfulness and brain changes that account for the benefits reported and compiled in studies on mental health (<http://www.campbellcollaboration.org/lib/project/117/>). These confirm that mindfulness changes the parts of the brain associated with reactive fight or flight responses, and brings them under conscious control. This accounts for improved executive functioning needed for both academic performance and good professional interactions. This month’s issue of “Mindful” magazine carries an extensive article titled “Is Mindfulness the Future of Therapy?” (August 2016, pp 46–56). A web search of that title brings up scores of articles that document the benefits of mindfulness.

The Dark Side

An introduction to mindfulness would be incomplete without reference to “The Dark Knight Project” <http://www.theatlantic.com/health/archive/2014/06/the-dark-knight-of-the-souls/372766/> or the recent article in *The Guardian*: “Is mindfulness making us ill?” <https://www.theguardian.com/lifeand-style/2016/jan/23/is-mindfulness->

making-us-ill. Both articles report the documentation of the adverse psychological effects credited to contemplative practices. After reading these articles, one wonders whether developing mindfulness offers risks. The Oxford Mindfulness Centre offers the article “Is mindfulness safe?” at <http://www.oxfordmindfulness.org/is-mindfulness-safe/>, which addresses this question. It shows that risks are probably nonexistent in the kinds of practices that we discuss here.

Source of Faculty Development in Mindfulness

Monash University regularly offers a free and very credible six-week online course on Mindfulness, with the next offering beginning September 19, 2016 (<https://www.futurelearn.com/partners/monash-university>). It is a “MOOC” (massive open online course) that requires about three hours of work time per week. Drs Craig Hassed and Richard Chambers, authors of the book *Mindful Learning* (Boston MA: Shambhala, 2015), provide the course. Their book is one that I highly recommend to both faculty developers and to faculty. Recruit a group of faculty to take the course together and meet a few times to share their individual outcomes. For most faculty, the course will likely be the first experience in either mindfulness or MOOCs.

Monash is a highly successful provider of online courses, but a quote from the instructors’ book *Mindful Learning* (p. 143) provides their interesting perspective on instructional technology:

It is fashionable to assume that being online opens up a larger world. It does offer a large volume of superficial experiences, but this is a poor replacement for the depth of experience associated with real interaction. . . . A general rule for teaching could be never to teach something on screen that could be taught with real tactile experience.

Until next time, meditate on that—mindfully. |||

Planning For A New Semester:

Where Did I Put Those Great Ideas?

Marilla Svinicki
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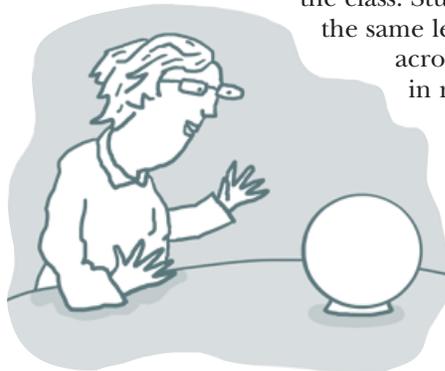
As I sit down to write this column, it is actually June 16th, 95 degrees outside, and I'm sure some folks would have trouble mustering enthusiasm for fall planning. Nevertheless, the end of one semester is probably the best time to write down all the things you wish you had done to help your classes go more smoothly the next time. In addition to your own list, I'm suggesting some things you can do to prepare first yourself and then your students for the start of classes this coming semester and all those ahead of you.

What will they know when they get there? What are your students going to be bringing to the class from their work in their previous courses? A helpful planning step is to review the place of your course in the students' curriculum. I often found myself thinking my course was an island and losing sight of the connections students should be making between my class and others they take. Reviewing where your course fits into the overall education of the students should help you think more globally about the course objectives, materials and activities. Although there is a strong tradition of not coordinating what students are learning across related courses, we now in general don't have to humbly ask colleagues for their syllabi to find out what the students should have learned—the syllabi are available online for many courses at many institutions. Perusing the syllabi of courses required for your course would not only avoid over-coverage of some topics and under-coverage

of others, but it should inspire you to help students make connections throughout the semester between those courses rather than treating them like the islands I mentioned earlier. Once you've done a review of the courses, you can build on their content to enrich your own. Students who can make cross course connections have a much better chance of grasping the big picture of their major and the institution's meaning of higher education. Not only will this improve their motivation, but it will also improve their long term retention of what they learned and possibly save everyone a lot of time in the long run.

What was difficult or easy for them to master? Another area where a review now would be useful for students in the future would be to analyze where students did exceptionally well in the courses just completed and where they seemed to struggle. Identifying difficulties could alert you to materials, activities or concepts that potentially might benefit from some rethinking about how to smooth out the learning curve. It might be something as simple as providing a glossary of terms (jargon) the students need to pay close attention to and commit to memory. Or it may be as complicated as finding a new source of materials online that students could access when they have problems. The online material might even be a podcast of your own explanations of difficult concepts along the lines of the Khan academy format reviews (Khanacademy.org). If you did this consistently across semesters, you could develop a large repertoire of support materials on basic concepts that you would no longer have to repeat in class multiple times.

How should they learn from your course? In a previous column



(“GAMES – your way,” *NTLF* V21N4, May, 2012) I discussed creating a study skills self-survey to alert the students how to learn in your course. It asks how often they use different study strategies that you think are important for the class. Students often use the same learning strategies across courses when in reality each one requires a slightly different strategy. Everybody likes to fill out self-quizzes. They fill out the survey and identify things they could be doing more frequently. Then you can provide hints about how to improve where their strategy use score is low.

Where did you put those ideas? Of course, you will come up with some really great ideas if you do this reflection right after the previous semester, but you also may forget about them or lose your notes. So a useful action for your own benefit would be to store these brilliant insights in a way that you can find them when you are ready to prepare for the upcoming semester. That would hopefully be more organized than post-it notes around your computer screen! |||

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