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### **Actively Learning to Teach**

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Today I had an interesting experience L while teaching my biochemistry class. I had students write the Krebs cycle on their digital whiteboards while keeping track of the specific carbons in the cycle intermediates. The point of this exercise was to have students understand how biochemists study metabolic pathways and to practice writing the chemistry of the cycle. To initiate the exercise, I explained the biochemical logic of the first reaction. After that, I let them go because we had already spent a lecture discussing the reactions. This produced a fairly lively classroom with students trying to understand the flow of both carbons and energy through the cycle. While they worked, I walked around commenting here and there as needed or when I saw a misconception arising. Clearly, learning was happening. But the weird thing was ... I didn't feel like I was teaching.

With active learning, we often discuss the culture shock that students feel. No longer is it sufficient for students to sit listening as passive consumers of information doled out by their instructor. An active learning class compels students to become actively engaged in applying the material and uncovering the consequences of their newly learned knowledge. But for those of us instructors who never had active learning modeled for us as students, the experience can be just as alien. It can be invigorating, as it was today when my students were working hard to understand the biochemical logic of the

reactions. But for me, it also felt like was I wasn't doing my job. I was reminded of those comments on my end-of-term course evaluations: "Haave didn't teach us! We had to learn it ourselves!"

Most of us have heard it said that the one doing all of the talking in the classroom is the one doing all of the learning. I've also heard it said that

No longer is it sufficient for students to sit listening as passive consumers of information doled out by their instructor.

we never truly learn a subject until we have to teach it. I wonder if this was what energized me when I first started teaching a couple of decades ago. I was learning the material I was teaching to a depth greater than I had ever achieved as a student, and that was invigorating. It was incredibly stressful to be constantly just ahead of the students, but so much fun to delve into my discipline and really grasp the details that I had just barely understood as an undergraduate.

Now, with active learning, I am no longer doing much of the talking—my students are doing most of that. That's as it should be. But I'm still experiencing a sense of loss. I'm no longer learning the same way I did when I lectured. But what is happening for me as an active learning instructor is that I am now learning which concepts trip up my students and how I can guide them through those bottlenecks. I'm also learning how to help them reflect on the misconceptions that prevent them from grasping the material at a deep level. I see how good this is for my teaching and students' learning. But I became a biochemist because I fell in love with the biochemical logic of the reactions that sustain our lives, not to guide someone else's learning.

To some extent, I wonder if the disorientation and disappointment I sometimes feel results from a sense of loss that I am no longer the center of my learning world-students are. I think this is similar to the transition from childhood to adulthood. With maturity comes the understanding that the universe does not revolve around us. For those of us who have children, our world includes them, and they have become the center of our universe. With active learning, we need to include our students in our learning center. This means stepping aside and letting students do the talking, thinking, doing, and learning-and then joining them in celebration of what they're accomplishing. 🗬

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### INSIGHTS



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## When the Professor Has Asperger's

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A sperger's syndrome is a functional type of autism spectrum disorder in which a person might exhibit social and physical awkwardness, slow monotone speech, fixation with certain topics, a reclusive nature, and minimal eye contact. These are a few of the many characteristics of Asperger's that can inhibit effective teaching.

I am officially diagnosed with Asperger's. I have a PhD and have been a university professor for over 30 years. I admit that my teaching evaluations early in my career were not stellar, but I have learned to significantly improve them given my limitations. I'd like to share what I've learned in the hopes of helping others who are teaching with Asperger's and for those who might be interested in learning what it takes to work around these limitations.

Awareness that you might have Asperger's is the first step. Sometimes you can find evidence for some Asperger's markers, such as monotone delivery, topic fixation, and social awkwardness in student comments on course evaluations. If these comments persist, you might consider consulting a licensed psychologist or another professional who can do official testing. Some free unofficial tests are also available online. Behavioral therapy (sometimes paid for with health insurance) can be helpful, but there's no medicine that reduces these lifelong symptoms.

One way I have found to reduce problems with my monotone delivery is to limit lectures to shorter segments and insert a variety of activities. For example, after a 15- to 20-minute lecture, I ask students to write down what was said as a quick review. I also break up lectures with quick surveys and short debates about whatever we are discussing. I secretly incorporate minilectures in a Jeopardy-style game I use to review my exams. I do that by elaborating on the terms discussed in the students' Jeopardy answers. Of course, dropping lectures and incorporating cases, role-plays, and other interactive learning methods are also options.

To further enhance my classroom lectures and show my enthusiasm, I talk about my research and race walking passions. Unfortunately, I sometimes mention those passions too much. Individuals with Asperger's tend to have few passions. They become experts but

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can bore others by sharing excessive details about the things that they love. To reduce this problem, I have learned to find examples from recent news events or work experiences that might be of more interest to students.

Empathy and social connections with students are more difficult with Asperger's. In this case, I work on modeling some of the best practices I have seen from colleagues. For example, when students come to my office, ask a question in class, or visit with me after class, I tell them that I appreciate their questions and concerns. That has worked. Listening attentively without staring at the student or having my mind wander in some other direction is a continuing challenge-but at least I am now more aware that this is happening. I also seek feedback and advice from a very few trusted mentors and relatives who can point out my weaknesses in a supportive rather than a negative way.

The strategies that have helped me become a better teacher won't work for everyone with Asperger's. There is no

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### A Retrospective Commentary on the Future of Teaching

"We are very good at teaching students how to solve problems for which we already know the answers. The challenge is to teach them strategies for tackling problems we've yet to solve."

Christopher Knapper made that comment when I interviewed him for an article, "What Should the Future of Teaching Be Like?" for the February 1988 issue of The Teaching Professor. Chris, now retired, was a professor of psychology and director of the Centre for Teaching and Learning at Queens University in Ontario. His visionary book, Lifelong Learning in Higher Education, coauthored with Arthur Cropley, describes a different kind of educational experience. It rests on the notion that learning can happen anywhere and at any time, not just in formal educational experiences that happen within designated time frames. I asked Chris to share his current thinking about education in light of the comment. Here's what he wrote.

When in 1988 I advocated teaching students how to cope with problems where the solutions were as yet unknown, in fact I should have gone further and included those problems that we have not even properly identified or defined. Including them implies an approach to higher education that goes far beyond mastering the conventional content of a field. Instead it focuses on cultivating students' capacities to develop their own flexible learning and self-evaluation strategiesstrategies that will inevitably change over time and in different contexts. I now think that even the notion of field of study is problematic, especially in a world where the problems we confront transcend traditional disciplinary boundaries, and in an era when only a minority of students will work in the field of their major.

Arthur Cropley and I were trying to argue for this broader kind of education in our book on lifelong learning—which, by the way, is a much misunderstood term that was subsequently hijacked and used as an all-purpose slogan for promoters of lifelong schooling and continuing education. Perhaps a better name would be life-wide learning. That term stresses the importance of learning not just over a lifetime, but also from a

"We are very good at teaching students how to solve problems for which we already know the answers."

wide range of sources beyond those encountered in school and college, including libraries, the Internet, friends, and colleagues. Paradoxically, this is the way most of us (including academics) learn new knowledge and skills, but not something we emphasize in most university courses.

Have the past 30 years seen changes in higher education that meet the goals we advocated? There is now a widespread, if not universal, acceptance of the notion that colleges need to prepare students to be creative, adaptable problem solvers. But walking this conceptual talk is another matter, and too much of our contemporary university education involves teacher talk rather than student thinking and doing. Teaching approaches are still predominantly didactic (and I include most MOOCs here), and a good deal of assessment of student learning is trivial and inauthentic. True, there have been some promising innovations such as problem-based and inquiry learning. But it is sadly the case that once the teachers directing such programs leave or the funding that launched them runs out, there is all too often a recidivism to the traditional. How do we explain this, when innovations in other spheres, such as manufacturing and health services, generally take root much more readily? There

root much more readily? There are many possible explanations, ranging from lack of preparation in teaching for most faculty (where North America lags badly behind Europe and Australia), academic rewards that emphasize research and publications over teaching effectiveness, increased faculty workloads, more part-time and contract teachers, and the declining morale that accompanies all these factors. But I suspect the main obstacle to sustaining change is the viselike grip that higher education institutions maintain over the credentialing system, along with complicit employers who use possession of a university degree in a traditional discipline as a surrogate for genuine evidence of ability and potential.

Despite the years that have passed since the observation I made in 1988, not enough change has occurred in what or how we teach students. Those who read and contribute to publications like these offer a glimmer of hope for the future, but the prevailing vision of higher education remains largely unchanged even though the world around us is an entirely different place.

**Reference:** Knapper, C. K., & Cropley, A. J. (2000). *Lifelong learning in higher education* (3rd ed.). London, UK: Kogan Page.

### **Figuring Out Feedback to Students**

How do we get students to act on the feedback we provide? When papers are returned, they look at the grade first and then (but not always) briefly peruse the comments. Do they read them more carefully at home? When asked, they say they do, but then the next paper comes in with little if any improvement in the areas targeted by the feedback. Do they need more comments? Fewer comments? Comments worded differently?

These questions don't have easy answers, but how the details relate is worth considering. In their study, Ackerman, Dommeyer, and Gross considered three factors related to feedback: (a) the amount (none, low, or high), (b) the source (from the instructor or provided by peers), and (c) the situation (whether revision was a possibility). They tested the interaction among these variables hypothetically. Students enrolled in introductory marketing courses from a broad range of business majors were asked to think about an assignment in a course they would be taking subsequently. They'd received a B- on a paper and it had been returned either with no feedback, just two comments, or 10 comments. The comments were from either the instructor or from peers, and students were told either that they could revise the paper or that revision wasn't an option.

The comments provided in the feedback were all critical and included statements like "no clear thesis statement," "no evidence presented to support idea," and "recommendations are not realistic." They opted to provide only negative feedback because they had found in a prestudy the addition of positive comments "made no significant difference in student responses from the use of just negative comments" (p. 21).

Not surprisingly, their results suggest that "receiving critical feedback generally elicits a negative response when it comes from the instructor . . . . Students overall felt angrier and less happy when they received a large number of feedback comments than when they received a low number of comments" (p. 24). The high number of negative comments also made the students more likely to think the instructor had a negative impression of them, and they liked the instructor less.

However, if students got that high level of negative feedback with the opportunity to revise the paper, their response was different. They reacted less negatively to the instructor, reported less anger, and rated the feedback as more helpful. They were also less satisfied with their grades on the paper—perhaps because they thought they could use the feedback to rewrite and then receive a higher grade.

The fact that students responded better to negative feedback from peers also sounds promising, albeit challenging to implement.

Some students got no, low, or high levels of critical feedback from peers instead of the instructor, and, in that case, students were more accepting of the feedback. "Students reacted less negatively to a high level of peer-provided feedback than to a high level of feedback provided by the instructor." Perhaps that response reflects less concern with the implications of the feedback—peers aren't the ones giving the grades.

The design of this study was interesting. However, it is a work that raises more questions than it answers. Can an instructor give too much critical feedback? Does it matter if students respond negatively not just to the feedback, but also to the instructor? Students who lack basic skills and don't come to learning tasks with a great deal of confidence can find too much negative feedback debilitating. If they conclude they can't succeed, aren't they more likely to stop trying? So finding the right amount of critical feedback depends on the individual students. These researchers recommend limiting the amount and making careful choices about where to focus it.

Do these findings make the case for assignments with revise and resubmit options? The researchers cite another study, documenting that when students were allowed to revise their work, they tended to be more involved in their own learning, and they more actively used the feedback to make changes: "Feedback given only at the end of a learning cycle ... is not effective for furthering student learning" (p. 20).

The fact that students responded better to negative feedback from peers also sounds promising, albeit challenging to implement. Students, especially beginning ones, are reluctant to offer critical feedback to peers—and if they do, will they provide the feedback that's needed to improve the work? In some studies they have, but in those cases, students were trained and used detailed rubrics, and grade incentives were involved—all of which entails more work for the instructor.

Feedback plays an essential role in learning, but few guidelines help teachers determine the amount and kind an individual learner needs.

**Reference:** Ackerman, D. S., Dommeyer, C. J., & Gross, B. L. (2017). The effects of source, revision possibility and amount of feedback on marketing students' impressions of feedback on an assignment. *Journal of Marketing Education*, 39 (1), 17–29.

# Doing More with Course Evaluation Feedback

Tsing end-of-course evaluation results to improve a course isn't always easy. Generally, the results are delivered after the fact. The course is over. The students are gone. That rules out any chance of making adjustments during the course, and it rules out clarifying any confusing aspects of the feedback. Perhaps, then, it isn't all that surprising that a lot of faculty members, 77 percent according to McDonnell and Dodd, don't change any aspect of the course based on the feedback, and those who do make changes tend to change very specific things, like the pace of the lectures. Other research documents that rating results remain stable: they don't change all that much, which could also be indicative that not much is changing in the course.

What if a faculty member decides to solicit feedback from students during the course and implement some changes based on their recommendations? That's the question McDonnell and Dodd tackled in this interesting research project. Students in an upper-division psychology course on perception provided evaluative feedback to the instructor four times during the course. Three times, they used a course feedback form that asked for their overall impressions of the course and if there were certain aspects of the course they'd like changed. At the end of the course, they also completed the formal end-of-semester rating form.

The aspects of the course that could be changed were identified during a brainstorming session conducted early

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single solution because there is a wide variety of symptoms. Some of the other symptoms that can hinder teaching include not understanding the emotions of others very well; long-winded, self-focused conversations; and few facial expressions. in the course. They included things like having more quizzes, more partner discussions during class sessions, more class discussion, and fill-in-the-blank PowerPoint slides during lectures, among others. Based on student feedback, three changes were identified, voted on by the class, and then implemented by the instructor: more supplementary videos shown in class, sample multiple-choice questions provided and answered at the end of each lecture, and more real-world examples included in the lectures.

Giving students multiple opportunities to provide feedback and then implementing their recommended changes produced a set of positive results in the course. More than 90 percent of the students indicated that the three changes improved the course. As has been observed in other work on instructional change, if students recommend a change, they have a stake in its success.

Second, student assessments of the instructor, the course, and how much they learned were all higher in the semester when the multiple evaluations occurred than in a previous section where they were not used. However, only the differences in ratings of the instructor reached a statistically significant level. For two of the three exams administered in the course, students outperformed those in the fall section who did only the end-of-course rating. Students responded favorably to this use of ratings, indicating they hoped other faculty would adopt the approach.

This study builds on work done

I feel that professors who suspect that a colleague has Asperger's should not toss that label at the colleague. It might not be understood, can threaten, and probably would not lead to specific behavioral changes. I recommend supportive ideas on how to reduce or modify specific behaviors related to Asperger's. A professor once suggested that I reduce the words and add more during the 1980s and 1990s that use of midcourse showed that evaluations frequently results in higher end-of-course evaluations. That research also documents the value of instructors sharing evaluation results with students, which happened in this study as well. These conversations show students that faculty their feedback seriously. They benefit the instructor by providing an opportunity to ask students about input that may be confusing or contradictory. It can be a process that teaches students the value of constructive feedback. They also learn how difficult it is for instructors to use policies and practices that work equally well for all students. In McDonnell and Dodd's study, the changes that were implemented were relatively small. That they had fairly dramatic effects shows the power of involving students in decision making about the structure of the course.

Technology now makes it easy to solicit and tabulate rating feedback. Doing so during the course can potentially improve the teaching and the learning, which is more than can be regularly said for end-of-course feedback.

**Reference:** McDonnell, G. P., & Dodd, M. D. (2017). Should students have the power to change course structure? Teaching of Psychology, 44(2), 91–99.

pictures to my PowerPoints to increase the stories I can tell. This simple and positive advice has worked to reduce my monotone reading of a fixed script. In the end, caring, constructive comments help all teachers improve.

# Can Relevant Assignments Change Perceptions in Required Courses?

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Required courses are among the most challenging to teach, and the lack of student motivation is one of the big reasons. Students don't want to take these courses. Most do not understand the justification for requiring them, especially those in fields that appear to be unrelated to their majors. Most teachers try to show the relevance of course content, but it almost always feels like an uphill battle without much success.

The situation is complicated further at large institutions where multiple sections of the same course are offered, often taught by graduate students without much teaching experience. That was the venue for the work done by Fedesco, Kentner, and Natt, which tried to get around the experience level of the instructors by tackling assignments used in a required public speaking course. Students taking the course routinely complained that the speaking assignments "had nothing to do with their majors" (p. 201). The faculty research team reasoned that course coordinators had more control over the assignments in the course than the instructional approaches used by those teaching the sections. Could they redesign the assignments in ways that would make the content and skills developed by the course more relevant to students?

To rework the assignments, the course director met with faculty from a wide range of departments (e.g., engineering, pharmacy, technology, English), asking them "to identify communication skills that incoming first-year students would use in major classes" (p. 201). Both those in the communication department and other departments observed that "students were often unable to equate presentation assignments and skills learned in the public speaking course with presentations they were making in their courses in their majors" (p. 201). And although the case in point here is discipline-specific, it is regularly true that students in a variety of required courses fail to see how they can use what they are learning in those courses in other courses and their professions.

Based on the feedback from those in other departments, assignments in the public speaking course were changed significantly. A table in the article compares the new assignments with those used previously. The new assignments were used in 27 sections of the course taught in the fall semester of 2015. Students in those sections

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responded to several surveys: one that asked about the relevance of the course material and others that measured motivation, course satisfaction, and perceptions of learning. Responses of those students were compared to the responses of students in 77 sections taught with the old assignments in the spring semester of 2015.

The new assignment configuration produced positive results. It changed students' perceptions of the relevance of the course. "These findings support the research that shows how the packaging of course material can be an effective strategy to increase perceived relevance" (p. 205). The more relevant assignments also impacted students' motivation. They reported higher levels of intrinsic motivation. "They were more likely to report that the reason they [were] participating in the course was that they enjoyed the material and . . . deemed it personally important, as compared with students in the preintervention condition" (p. 205).

The measure of overall course satisfaction did not show higher levels for students in the experimental sections. The research teams wondered if that could have been the result of the new assignments being implemented across multiple sections taught by a variety of instructors using different approaches. On the other hand, students did report greater perceptions of learning. The researchers are quick to point out that students' perceptions of how much knowledge they've gained are not as reliable as measures that document actual changes in what students learned. Higher perceptions of learning "may be more indicative of overall course satisfaction and motivation to apply knowledge" (p. 205). Even so, when students think they have learned more in a course, that positively impacts their feelings about the course and its content.

In general, not enough attention is paid to course assignments as should be. They tend to be pretty consistent across courses and disciplines. This study shows that if they are designed to be responsive to skills students need in their major courses, that can change perceptions of a required course, and anything that changes what students think about required courses is worth serious consideration.

**Reference:** Fedesco, H. N., Kentner, A., & Natt, J. (2017). The effect of relevance strategies on student perceptions of introductory courses. *Communication Education*, 66(2), 196–209.

### **Students Teaching Students**

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Educators continue to provide excellent learning opportunities that develop the knowledge and skills required by disciplines. But generally the focus is on what students need to know and be able to do within that discipline only. If there is an attempt to provide an interdisciplinary experience, it is usually a short, token learning experience that might involve guest speakers, videos, or classroom discussion. These experiences tend to be passive and do not promote development of interdisciplinary teamwork skills now regularly required in many professions. How to deepen students' appreciation other for disciplines-that's the challenge facing many teachers.

Let me use my field, physical therapy (PT), to illustrate the importance of an interdisciplinary perspective for our students. Our aging population has complex needs, which requires health care professionals with increasingly specialized knowledge and roles. The future health care professional needs not only to have knowledge and skills of one discipline, but also to embrace the importance of multiprofessional teamwork. Almost always now, the needs of the population we serve require the response of a team of professionals from different fields that can work together toward common goals.

A colleague and I chose to experiment with an active learning project that involved students teaching students. It linked my PT students with my colleague's occupational therapy (OT) students. We hoped it would benefit both groups. The project involved three phases: (1) student preparation, (2) interdisciplinary interaction, and (3) reflection. Instructors interested in designing interdisciplinary activities need to select mutually beneficial content and carefully plan the interaction. In this case, we selected home adaptive equipment and modifications as the content.

As the PT professor, I prepared my students with a hypothetical case. It involved an elderly grandmother who needed to live with her grandchild (the PT students acted as the grandchildren) and was being discharged with only a wheelchair and Medicaid funding. After viewing a video of the grandmother's abilities, receiving additional documentation about her, and incorporating an assessment of the home, the PT students had to determine the best solution for modifying the home and what equipment their grandmother would need given those home modifications. They were encouraged to direct their questions to the OT students

How to deepen students' appreciation for other disciplines—that's the challenge facing many teachers.

and consult with them. The PT students were to function as expert advocates for their grandmother who was coming to live with them in their home.

The OT instructor worked with her students on the use of various home adaptive aides and their appropriate application in each room of the house. Aids such as elevated toilet seats, bathtub benches and bars, antifog mirrors, and wheelchair-accessible sinks are appropriate in the bathroom. Next, the OT instructor discussed ways the OT students could teach the PT students about these aids. Their assignment was to present a 10–15-minute active teaching module incorporating teaching skills obtained in previous coursework. The OT students were to educate the PT students about their assigned home adaptive aid and its use in the kitchen, bathroom, or elsewhere in the home. They also were to act as consultants with the PT students.

The interdisciplinary interaction occurred at seven set-up stations, four in the modified OT home and three in an OT lab that had a kitchen and bathroom. Three lab assistants helped my colleague and me supervise this activity. The students were placed in small groups of 3-4 students. The OT students stayed at their stations and repeated their session for each new group of PT students. The PT students rotated to a new station every 10-15 minutes so that, by the end, they had experienced every room of the home and the equipment appropriate for it.

The final phase involved reflection, but with a different emphasis for each group. The OT students responded to questions about their abilities as educators as well as how they interacted with the OT students. The PT students focused on how they were going to modify their homes and select equipment for their grandmother as well as how they interacted with the OT students. Each of the instructors followed up with a class discussion. Ninety-four percent of the students either strongly agreed or agreed that collaboration with other health care professionals and teamwork is important. The activity made clear the value of working across professions. As one OT student stated, "I think that the most valuable part of this was the ability to collaborate."

This activity deepened students' content knowledge, helped them with communication skills, reinforced the value of problem-solving and collaboration skills, and, most importantly, deepened their appreciation of cross-disciplinary teamwork. Students teaching students helped our students in many ways!

### **Tackling Testing Anxiety**

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fost entry-level science classes Lare test-centric, meaning that the course grade is based primarily on tests and only minimally on homework, quizzes, or other grades. For students with test anxiety, that can be devastating. Yet testing remains the primary way students are evaluated in courses in science and many other fields. Test anxiety can be reduced by making the exams count less and letting the homework assignments or quizzes count more in the course grade calculation. Others have recommended and used alternative types of testing, such as group presentations or concept maps. I was looking for ways to ease the exam anxiety some students experience, but I was also committed to maintaining the rigor of the course. I decided to try using both group and individual tests to see if and how they eased the students' test anxiety.

The entry-level chemistry course in which I implemented this testing method is taken mostly by students wanting to enter the nursing profession. The class is culturally diverse and includes a mix of traditional and nontraditional students. Many in the class did not take chemistry in high school, so this is their first introduction to the field. I find that most of my students are hard workers who really want to understand the material in the course. They recognize its importance. Yet on test day, these same students often do not perform well. My goals were to ease their test anxiety and boost their confidence and that of the rest of the students as well.

I administered a group test for the first 15 minutes of the testing period, followed by individual tests for the remainder of the period (60 minutes). Students self-selected their groups, with three or four students per group. The group test counted for 20 percent of the grade and the individual exam for 80 percent. I hoped that allowing students to work together on a set of problems before the main portion of the test would reduce the anxiety of those students who understood the material but needed reassurance. I wanted them to relax and feel confident as they started working on their individual exams.

What I have found from using this strategy is that, generally speaking, there is a small majority of students for whom this works. Those students report that they feel slightly more relaxed and also indicate that they remember the material better because they've just had a chance to work on it. The test scores improved marginally, but the testing strategy did reduce the anxiety experienced by some students.

The primary drawback to using group testing is that one or two students each semester report not working well with their group. Usually, this happens on the first exam. To address the problem, I encourage students to identify two or three classmates with whom they think they can work well and to do some studying and work together, and if that goes well, then they can select to work with each other on the exam. I also allow students one do-over of their group test if I determine that the situation warrants it. They must agree to drop the score on their original group exam and they take an alternative version of the group test along with others who are doing a make-up exam. They can take the group test by themselves if no one else in the group decides to retake the group exam.

No single approach successfully eliminates all test anxiety, but I have found that using group testing along with individual testing does help many of my students, and, at the same time, maintains the necessary rigor of the testing process.

