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STEM Lunch #2: Reconsidering class time through flipped learning

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Recap: Study skills, flipped learning, and more at spring STEM teaching lunches

With the final spring STEM teaching lunch coming up on March 4th, here's a recap of what you missed at the first two lunches.

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One thing I've learned as I've gotten to know the campus over the last year and a half is that there are a lot of faculty and staff invested in student learning and success in the STEM fields. I keep running into folks who are redesigning courses or experimenting with teaching strategies or building new programs to support students. Plus there's that new Duff Center for Science and Technology Innovation that is opening soon, full of shiny new active learning classrooms to host STEM courses.

Clearly, STEM teaching is having a moment here, which is why CETL launched a series of STEM teaching lunches this academic year. Each event in this series features a different set of panelists doing interesting things in STEM teaching at the University of Mississippi, and each event is in person with lunch provided by CETL. We held three lunches in the fall (which you can read about here), and two so far this spring, with our final spring lunch scheduled for March 4th.

February 8th - Helping students learn how to learn

Our first event this spring featured assistant professor of biology **Sharday Ewell**, new to the campus this year as part of a cluster hire of biology and chemistry faculty who conduct discipline-based educational research. Sharday's research combines quantitative and qualitative methods to investigate the development of self-regulated learning skills in students enrolled in undergraduate STEM courses, and she shared some of her research with us at the lunch on February 8th.

Sharday began by distinguishing between different kinds of study strategies: surface strategies like highlighting and re-reading that aren't correlated with learning and deep strategies like self-testing and elaboration that are more work for students but also more effective. Prior research

shows that instructors generally expect students to have good study strategies in STEM courses, but that students generally don't and they don't even know which strategies are more or less effective.

Sharday's research team at Auburn University surveyed students in three undergraduate biology courses after key exams to ask what study strategies the students used. They expected students in the higher level courses to use more effective study strategies, but there was almost no difference in strategies used across the courses. And when they asked students to identify why they used particular study strategies, the majority of students could not do so! Even students who used effective strategies often couldn't articulate why those strategies work, just as I can't tell you how my car works to get me to campus in the morning and yet it does.

At this point, Sharday asked those of us in the room to do a think-pair-share around the question, What can instructors do to help students adopt more effective study strategies? Lots of ideas were shared, from advising students on strategies to sharing "how to do well in this course" messages from former students to creating virtual flash cards for students to study from. Sharday noted that explicit instruction in study strategies can be very useful for students, but this works best when it's embedded in the learning context, not shared in some external study skills course.

The problem is, as Sharday noted, that explicit instruction in study strategies is a big lift for faculty who often teach courses packed with material. Sharday recommended we do more with our existing course syllabuses to point students toward effective study strategies. She then shared a new study she and her team are conducting that looks at a collection of biology course syllabuses. How many of these syllabuses mentioned study behaviors at all? Just 60%, and 65% of those recommended at least one ineffective surface strategy. Clearly there's room for improvement in how we talk to students about studying through our syllabuses.

I took the opportunity to ask the awkward question: Why use the syllabus for this purpose when students are notorious for not reading the syllabus? Sharday then shared a couple examples of welcoming course syllabuses, including one of her own, that use tone, wording, and graphic design to engage students in taking the syllabus seriously and returning to it throughout the course. Bonus: A warm and welcoming syllabus has also been shown to evoke in students the perception that their instructor is more approachable and more motivated to teach the course.

Sharday encouraged those present at the lunch to rethink their syllabuses and how they talk to students about studying effectively. I would add to that an encouragement to find ways to build effective study practices into the structure of one's course. Perhaps start a class session with a three-minute quiz over key terms to provide all students with some retrieval practice, or ask

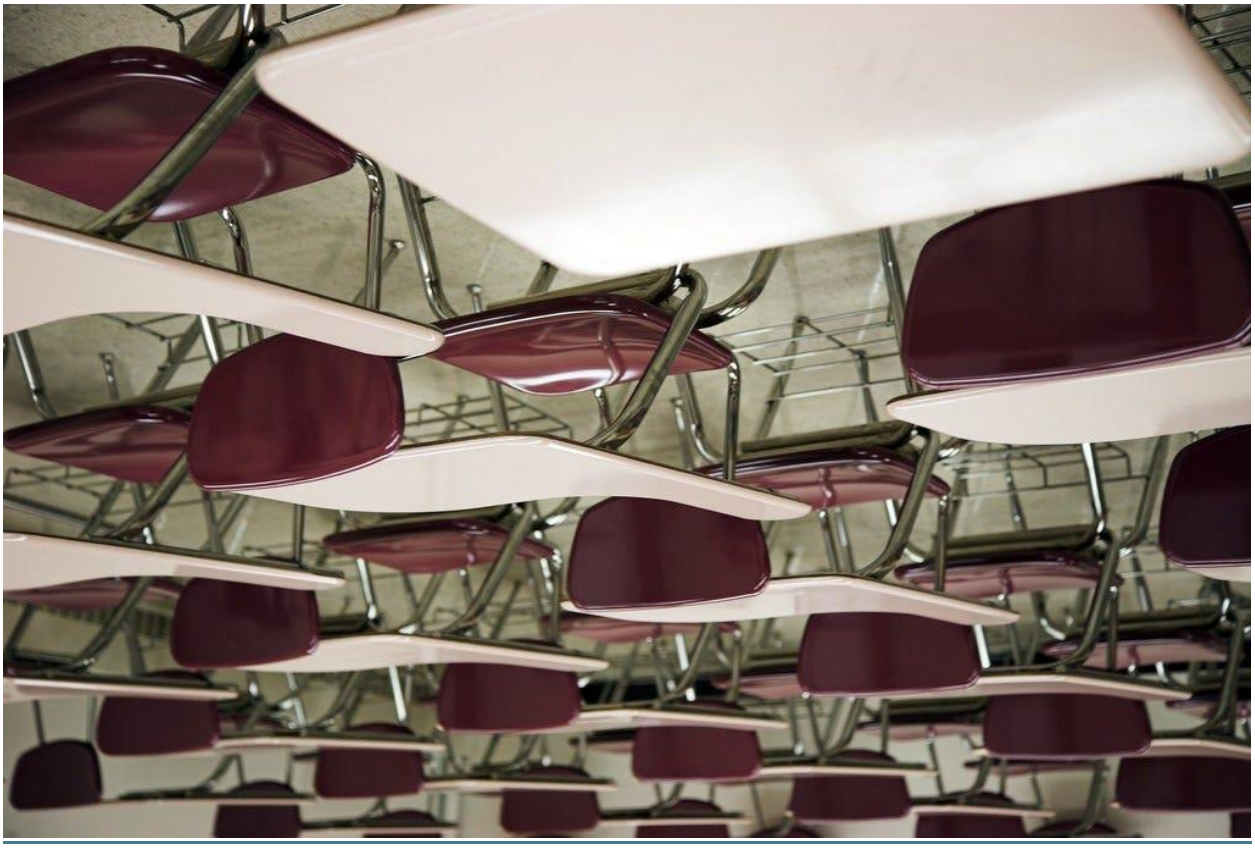
students on a homework set to provide not only solve a problem but also write a short paragraph about the concepts involved in that problem, or plan a few metacognition activities (ones where students think about their own thinking) as described here.

February 20th - Reconsidering class time through flipped learning

The second STEM teaching lunch this spring was held on February 20th and brought together a panel of instructors to discuss their experiences with flipped learning. What is flipped learning? Allow me to quote Robert Talbert, author of the 2017 book *Flipped Learning: A Guide for Higher Education Faculty*.

"Flipped Learning is a pedagogical approach in which first contact with new concepts moves from the group learning space to the individual learning space in the form of structured activity, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter."

Often called the flipped classroom, this approach to course design offers a contrast to more traditional forms of STEM instruction in which students encounter material for the first time in a lecture and then have to make sense of that material on their own through homework exercises. As Harvard physics professor Eric Mazur has often said, the second part of that learning sequence is the harder one, so why not do it during class when other students and the instructors are around to help?



Daniell Mattern, professor of chemistry and biochemistry, shared his experiences with flipped learning, which started during the COVID-19 pandemic and the resulting shift to online instruction. That teaching format prompted him to pre-record his lectures for organic chemistry, which allowed him to use synchronous time with students on Zoom for problem solving. This worked so well that he continued the flipped approach when classes resumed in person.

Dan typically organizes his in-class activities with worksheets, which students complete in groups of size four, with groups changing members randomly each week. Dan shared some grade data from his courses indicating this flipped approach is successful for his honors courses. He also shared some informal student feedback. Perhaps my favorite comment was the one in which student said that the flipped approach "made studying for tests easier," presumably because they were learning the material along the way.

Mike Gill, professor of the practice of chemical engineering, also talked about the ways he organizes his class sessions to promote active learning. Whether it's an introductory course in chemical engineering or a more advanced course on manufacturing efficiency, Mike regularly uses informal groups for class activities. He said that some of his students will try to sit out these activities, just watching their peers, but he'll intervene and encourage them to engage.

I've heard this challenge from other instructors, too, and while mandating group participation can be problematic (particularly for neurodivergent students), college students often have to learn how to participate well in group settings, so some encouragement and skill building is often warranted.

Mike also mentioned that he likes to give one of the student groups a special role in the activity, and then reveal that hidden role at some point during class. For example, during a class discussion on oil spills, he had one group reveal halfway through that they were representing an environmental justice group, but only after one student said something like, "What's the big deal if a few birds don't make it?"

Sidebar: I feel like I need to gently push back on one thing that Mike Gill said during the Q&A at the event. In the context of a question about getting students to come to class prepared, Mike mentioned his "professionalism" course policy, which is designed to encourage students to come to class on time, to come to class prepared, and so on. He mentioned that students can earn up to five points on their course grade if they act professional in these ways, but also that they can lose points if they act unprofessional. As an example, he mentioned calling out a student who was apparently texting on his phone during class and deducting points from that student's grade for doing so.

Two points on this... One is a point I've heard CETL director Josh Eyler say many times, that the grade a student is given in a class is not necessarily representative of what they have learned in this course, and this professionalism policy is an example of that. The student texting on his phone during class might have mastered the course material, but that student's grade will be lower because of some non-learning metric. The other point is that a student might have many perfectly understandable reasons for texting during class. Maybe they have a sick parent or a sick child or a roommate in crisis. Sure, a student expecting an emergency text during class might tell their instructor ahead of time, but they might not, and I would tend to err on the side of compassion with my course policies.

Okay, back to the panel...

Our third faculty panelist was **Elliott Hutchcraft**, associate professor of electrical and computer engineering. He talked about the electronics course he flips, with students watching his pre-recorded lecture videos before class and spending their class time working problems in groups. Part of the inspiration for this approach was realizing during an exam review session, in which students were working problems in groups, that different students can approach the same problem in different ways. Having students hear about their peers' approaches can be a valuable learning experience. Now he builds that kind of interaction into his courses regularly.

Elliott said that the biggest challenge in his flipped approach is getting students to watch and interact with the pre-class videos. He learned early on that long videos aren't going to be watched by students, so he keeps his videos short, maybe 5 to 10 minutes each. He noted that sometimes it's his good students that are most likely to skip the videos, thinking they can just get the material in class, but they actually need more time on task with the material.

Bibek Kattel is a doctoral student in electrical engineering, and he had the chance to teach that electronics course recently when Elliott was on sabbatical. Bibek noticed that the students seemed to need just a bit more direct instruction at the start of class before tackling the day's problems, so he has been experimenting with mini-lectures that "unflip" the course, but just by a little. You can read more about Bibek's experiment in a recent CETL blog post.

When I asked the panelists if the flipped approach changed their relationship with students, both Dan and Bibek answered enthusiastically that spending class time circulating among students working problems has meant much more interaction and engagement with their students, as well as a stronger sense of rapport in their courses.

March 4th - Course design for student success

Our third and final STEM teaching lunch is scheduled for Monday, March 4th, from 12 to 1pm in the Johnson Commons east banquet room. Sometimes small changes in the design of our courses can result in big improvements in student learning. In this session, we will hear from two participants in CETL's Inclusive Teaching Learning Community, **Ayla Gafni** (mathematics) and **Isis da Costa Arantes** (biology), about changes they made to their courses to promote student success. Lunch is provided to registered participants, and you can register here.