Instructors are sending lectures home to use class time for interactive learning.

Elizabeth McCormack wanted more classroom time to work on group problem solving with her students. But lectures, as is tradition, ate up most of their time together. So two years ago she flipped her sophomore electromagnetics class on its head. Instead of sitting during class while she lectured, McCormack’s students at Bryn Mawr College watched a series of short videos on their own time that covered the lecture material. Only one of three classes each week featured lectures. That freed up the other two classes for working through problems with each other on the board.

At first, McCormack’s students weren’t thrilled with the new format. They even showed up en masse at her office door to make the case for more lectures. They weren’t confident in their grasp of some of the material, they told her. The videos were missing that immediate dialogue with the professor to answer their pressing questions.

“What they were really telling me is that they needed more opportunity to talk about the material, to talk about the challenging pieces,” says McCormack.

In response, she added some lectures back in, and then included “co-reading” homework assignments where students had to work in small groups and bring three questions that the group couldn’t sort out to the next class. It pushed them to discuss what they were reading, she says.

Flipping, an idea that gained momentum around 2010, makes room for applied learning in class. Students take in the lecture material on their own time—often through videos made by the instructor or an outside source—then come to class prepared to ask questions and do hands-on work.

Instructors can assess whether students are actually watching the videos by using online surveys, quizzes at the beginning of class, or questions the students answer in class with a hand-held remote, or clicker.

According to a September 2013 special report in the Chronicle of Higher Education, the National Center for Academic Transformation has helped redesign about 300 college courses since 1999, many in a flipped format.

Hard data on the impact of flipping are hard to come by, but some professors who’ve tried the flipped format see improvements among their middle- to lower-performing students. Emily Niemeyer, a chemistry professor at Southwestern University in Georgetown, TX, introduced “Flipped Fridays” in her introductory chemistry class in spring 2013 as part of an HHMI grant. With those flipped classes, she says, she’s had fewer students performing in the C and D range, and many more in the B range.

Diane O’Dowd, HHMI professor and chair of developmental and cell biology at University of California, Irvine, and her co-instructor, Adrienne Williams, have compared a small, fully flipped introductory biology course with a larger, partially flipped class in 2012 and 2013. Singling out the students with low SAT scores, O’Dowd’s preliminary data show that the students in the flipped class outperformed by 7 percent the students in the partially flipped class on identical final exam questions.

O’Dowd says that beyond test scores, flipped classes can be rewarding for faculty who like a challenge. “Most of us became scientists because we want to do things that are intellectually stimulating,” says O’Dowd.

Physics Nobelist Carl Wieman, now teaching at Stanford University, has been experimenting with alternatives to the traditional lecture format for 15 years. He doesn’t lecture and offers pre-class reading assignments. Wieman calls his classes “an ongoing problem-solving activity where the students are regularly getting feedback and interactions along the way, both from their internal discussion and from the instructor.” Before moving to Stanford, he compared the results of two Introduction to Modern Physics courses in 2011 where he taught at the University of British Columbia. One had a traditional lecture format. The other had pre-class reading assignments, peer discussion, clicker questions, small-group activities, and minimal lecturing. Both had about 60 students. Those in the latter class, with the problem-solving format, scored 18 points higher—85 percent versus 67 percent—on a standard test of knowledge of quantum mechanics.

Working it out

McCormack, chair of Bryn Mawr’s physics department, wanted to give her students a better conceptual and operational understanding of the topics, provide them more opportunities to practice the mathematical framework in class, and lock in their learning with more writing and problem-solving skills. She’s been learning as she goes.

After experimenting with the flipped format for two years, McCormack found that the videos have to be short—less than 10 minutes. Sometimes, she makes them up on the fly if questions come up or if students are having
trouble grasping certain material. “You have to let go of being rigidly prepared,” she says.

At University of Maryland College Park (UMCP), flipped classes in life sciences and introductory physics have almost no in-class lecturing, says Katerina Thompson, UMCP’s director of undergraduate research and internship programs and a leader of HHMI’s National Experiment in Undergraduate Science Education (NEXUS). Students watch videos or complete assigned readings on their own time, and then answer online questions that give the instructor a sense of how well they’ve grasped the material. From there, the instructor decides what to highlight when the class meets again.

In the physics courses, “we developed almost everything from scratch,” including the videos and online textbook, Thompson says. Students are given dry-erase boards and markers to work through a conceptual question requiring them to apply what was in their reading. In biology, some flipped courses use custom created video lectures, while others make use of videos that are freely available on the Internet.

Using clickers, students can see a distribution of answers from their classmates, Thompson says. “Then we get into a discussion of ‘Why did you choose this one and why did you choose that one?’” They then break into small groups and start rethinking their answers.

For the flipped concept to work, Thompson says, faculty have to buy in. It can require more prep time and interaction with students than the traditional lecture format.

“There are some faculty who are very interested in adopting new things and jump in with both feet, and then there are some who are more hesitant.” Right now, she says, “It’s a coalition of the willing.”

To build that coalition, UMCP is offering small grants to faculty to revamp their courses, along with multi-day training institutes, short workshops, and faculty learning communities. —Laura Putre