A Guide to the Flipped Classroom

INSIDE

Professors have been "flipping" their courses for years, but the idea still elicits controversy.

While the term is often applied to a range of approaches to teaching, flipping in its various forms involves a key trait: It inverts the traditional relationship of students and faculty members. Instead of passively receiving course content during class, students digest the information outside of class on their own time. They might read written materials, watch previously recorded lectures, or listen to a podcast. Once they are in class with their instructors, students spend time answering questions, discussing material, or working in groups. The method has attracted particular attention in recent years in science, technology, engineering, and mathematics courses.

At its root, advocates say, flipping seeks to put the learner at the center of a course instead of the teacher. While proponents say it's a more effective technique than a traditional lecture, many students chafe at it. A significant number of professors try it, struggle, and quickly revert to straight lecturing. What do you need to think about if you're considering flipping? Here are some resources to guide you.

How ‘Flipping’ the Classroom Can Improve the Traditional Lecture

By DAN BERRETT

Andrew P. Martin loves it when his lectures break out in chaos.

It happens frequently, when he asks the 80 students in his evolutionary-biology class at the University of Colorado at Boulder to work in small groups to solve a problem, or when he asks them to persuade one another that the answer they arrived at before class is correct.

When they start working together, his students rarely stay in their seats, which are bolted to the floor. Instead they gather in the hallway or in the aisles, or spill toward the front of the room, where the professor typically stands.

Mr. Martin, a professor of ecology and evolutionary biology, drops in on the discussions, asking and answering questions, and hearing where students are stumped. “Students are effectively educating each other,” he says of the din that overtakes his room. “It means they’re in control, and not me.”

Such moments of chaos are embraced by advocates of a teaching technique called “flipping.” As its name suggests, flipping describes the inversion of expectations in the traditional college lecture. It takes many forms, including interactive engagement, just-in-time teaching (in which students respond to Web-based questions before class, and the professor uses this feedback to inform his or her teaching), and peer instruction.

But the techniques all share the same underlying imperative: Students cannot passively receive material in class, which is one reason some students dislike flipping. Instead they gather the information largely outside of class, by reading, watching recorded lectures, or listening to podcasts.

And when they are in class, students do what is typically thought to be homework, solving problems with their professors or peers, and applying what they learn to new contexts. They continue this process on their own outside class.

THE TAKEAWAY

The teaching technique is on the rise, thanks to a confluence of factors—including technology and economic reality.

The immediacy of teaching in this way enables students’ misconceptions to be corrected well before they emerge on a midterm or final exam. The result, according to a growing body of research, is more learning.

While the idea is not new, the topic of flipping has consistently cropped up during discussions at recent conferences about teaching and learning—and often when the subject turns to science, technology, engineering, and mathematics, or the STEM disciplines.

The recent interest is driven by the convergence of several trends.

The first is technological innovation, which has made it easier to distribute lectures by the world's leading instructors. Some faculty members wonder whether it still makes sense to deliver a lecture when students can see the same material covered more authoritatively and engagingly—and at their own pace and on their own schedule. The supply of such offerings, at low or no cost, is increasing, as demonstrated by recent news of the Massachusetts Institute of Technology's founding of MITx and a Stanford University professor's start-up of Udacity.

At the same time, policy makers, scholars, advocacy groups, and others who seek to improve higher education want to see more evidence that students are truly learning in college. As pressure mounts to graduate more students, and as cognitive psychology produces new insights into how students learn, these observers say professors can no longer simply pump out information and take it on faith that students understand it.

Adding to these forces is economic reality. Strained budgets make it difficult for colleges to decrease class sizes and create more seminars in which low student-to-professor ratios allow a high degree of personal attention. Even advocates for new approaches to teaching concede that the lecture is not going away. The lecture model—putting dozens, hundreds, or even thousands of students in a room with a professor—endures because it makes economic sense.

Flipping allows colleges, particularly large research institutions with big classes, to make the traditional lecture model more productive, says Harrison Keller, vice provost for higher-education policy at the University of Texas at Austin, which held a recent seminar on course flipping for its faculty. "If you do this well, you can use faculty members' time and expertise more appropriately, and you can also use your facilities more efficiently," he says. More important, "you can get better student-learning outcomes."

Those forces are coming together to prompt a rethinking of the faculty member's role in the classroom. "I see a paradigm shift, and it's coming soon," says Michael S. Palmer, an associate professor of chemistry and assistant director of the Teaching Resource Center at the University of Virginia. "Content is not going to be the thing we do. We're going to help unpack that content."

Identifying Key Concepts

Professors have flipped courses for decades. Humanities professors expect their students to read a novel on their own and do not dedicate class time to going over the plot. Class time is devoted to exploring symbolism or drawing out themes. And law professors have long used the Socratic method in large lectures, which compels students to study the material before class or risk buckling under a barrage of their professor's questions.

The way STEM disciplines are traditionally taught makes them particularly ripe for change, Mr. Palmer says, because of their "long tradition of very didactic teaching, which involved disseminating content." By contrast, he says, the humanities and social sciences have been about exploring ideas.

Still, flipping has been adopted in isolated precincts of STEM disciplines, particularly physics. Some of the most notable examples illustrate the different forms the technique can take.

At the University of Michigan at Ann Arbor, for example, the math department has flipped its teaching of calculus since the mid-1990s, says Karen Rhea, a lecturer and director of the introductory mathematics program.

Michigan offers up to 60 small sections of introductory calculus, with a maximum of 32 students in each class, which meet for 80 minutes three days a week. Faculty members receive intense training: a weeklong course at the end of August, followed by weekly meetings and regular classroom visits throughout the semester from more-experienced instructors.

Consistent with the flipping model, students at Michigan do their reading before class. The instructor gives a brief lecture, asks them about the reading, and goes through an example from the textbook. Students take turns going to the board to present their answers or working in groups, which might be followed by another short lecture.

As the students work on the next problem, the instructor circulates. Rather than sending students home to struggle with a new concept, the instructors can hear—and correct—misunderstandings as they arise. "We're asking them to solve problems that are not template problems," Ms. Rhea says. "In your presence they're learning how to think, and we're learning what they're struggling with."

Class size is not the most important factor in teaching this way, Ms. Rhea says. What's more critical is teaching and testing a set of basic principles of differential calculus that are articulated in a test called a calculus concept inventory. This 22-question test focuses not on whether students can run through calculations but on whether they understand the underlying concepts.

"It's easy to measure if they can take derivatives out the wazoo," Ms. Rhea says, "but it's kind of harder to see what they're getting underneath."

"We put a lot of emphasis on the transfer of information."

Research by Ms. Rhea and two colleagues suggests that Michigan's teaching methods have led to greater gains in conceptual understanding. The techniques have been lauded by the Association of American Universities, among others.

In 2008, Michigan gave concept inventories to students before they started calculus and after they finished, and calculated the difference relative to the maximum gain they could have made. Students in Michigan's flipped courses showed gains at about twice the rate of those in traditional lectures at other institutions who took the same inventories.

The students at Michigan who fared worst—a group of 12 who were at risk of failing the course—showed the same gain as those who demonstrated the largest increase in understanding from traditional lectures elsewhere.

A View From the Lecture Hall

Michigan's program did not randomly assign its own students to courses using different teaching models, as conventional education research would dictate. But the gains in learning that were observed at Michigan correspond with similar findings about teaching methodologies in physics, which have been documented by Richard R. Hake, a professor emeritus of physics at Indiana University at Bloomington.

In fact, the project at Michigan was modeled on similar work by physicists, who have been among the most innovative STEM scholars in trying new approaches to teaching and testing the results.

One of the most outspoken physicists is Eric Mazur of Harvard University. He has been flipping courses for 21 years using a method he calls "peer instruction," in which students work in small groups to answer conceptual questions during lectures. Mr. Mazur recently established a network of practitioners in the technique.

He began to use peer instruction after testing his own students on the force concept inventory, which predates the calculus concept inventory, and which tests understanding of the foundations of Newtonian mechanics. Despite his consistently high ratings from students, Mr. Mazur saw that they were not learning as much as he thought they were.

"We put a lot of emphasis on the transfer of information," Mr. Mazur said at a recent conference at Harvard on teaching and learning. But that model is making less sense as sources of information grow more plentiful. "Simply transmitting information should not be the focus of teaching; helping students to assimilate that information should."

At the conference, he demonstrated how his methods help students absorb information and transfer concepts. He briefly explained an aspect of thermodynamics: When molecules are heated, they move away from one another.

After asking if there were any questions on this concept, he told the attendees to pick up their electronic "clickers" to answer a question. It was not a simple test of comprehension; he asked people to apply the concept to a new context.

Imagine a rectangular sheet of metal with a circle cut out of the middle, he said. What would happen to the diameter of the circular gap if the metal were to be heated uniformly? Would the diameter of the hole get bigger, stay the same, or shrink?

The attendees entered their answers on their clickers. Mr. Mazur told them to find someone sitting near them who had chosen a different answer and try to persuade them that their answer was correct. The room quickly grew noisy.

I answered that the gap would get smaller, figuring that the material would melt and the hole would start to close. Behind me, a psychologist explained how he thought it would remain the same because the interplay between the expanding metal and the air in the middle would balance each other. We went back and forth, failing to change the other's mind.

Mr. Mazur ended the discussion and began to move on to a new point when people in the audience started protesting. As it turns out, both my neighbor and I were wrong: The hole would expand, as happens when a jar's metal lid is heated.

"Once you engage the students' minds," Mr. Mazur said, "there's an eagerness to learn, to be right, to master."

Active Learning

But such eagerness is not much in evidence on students' evaluations, says Melissa E. Franklin, chair of Harvard's physics department. While she does not defend the traditional lecture and lauds Mr. Mazur for advancing the cause of teaching, she views flipping with some skepticism.

Harvard colleagues have tried flipping, Ms. Franklin says, but few have stuck with it. It demands that faculty members be good at answering students' questions on the spot, even when their misconceptions are not yet clear because they are still processing the information.

It can also be very labor-intensive for faculty members who do not have teaching support, she adds, if it requires a professor to read questions that students submit before class (which is characteristic of just-in-time teaching). "For a normal, straight-ahead professor, there's a steep learning curve," Ms. Franklin says.

But her chief critique is based on the intensity of students' responses. The average score on a student evaluation of a flipped course is about half what the same professor gets when using the traditional lecture, she says. "When the students are feeling really bad about required courses, it doesn't seem like a good thing."

Mr. Mazur concedes that some students resist participating to the extent his technique demands. Many students have done quite well receiving information and spitting it back out, he says. But while some come to embrace the flipped classroom, others never do.

Liking the class is ultimately beside the point, Mr. Mazur says. He says his results from using peer instruction show that, on the force concept inventory, nonmajors who take his class outperform physics majors who learn in traditional lectures.

"You want students to like class, but that's not the goal of education," Mr. Mazur says. "I could give them foot massages and they'd like it."

Matt C. Hudson, a senior who is double-majoring in physiology and evolutionary biology, learned to appreciate the flipped classroom while taking Mr. Martin's class at Colorado, just as Mr. Mazur says his students sometimes did in his classes at Harvard.

"I really was caught off guard at first," says Mr. Hudson, who was initially adamant that students taking a lecture class should be lectured to. About three weeks into the course, his view changed.

Mr. Martin split the students into small groups to discuss the heritability of beak sizes in finches, and how that trait related to a bird's chance of survival.

When a fellow student explained the relationship to him, the link became clear. "Having six or seven ways to think about a problem is better than just having your own way to think about a problem," Mr. Hudson says.

As both Mr. Mazur's and Mr. Martin's classes indicate, the cognitive strain that flipping imposes on students accounts for much of its success—and the resistance it engenders. Ultimately that strain is what is most important, not whether the course is flipped, says Carl E. Wieman, associate director of the White House Office of Science and Technology Policy. He has documented gains when relatively inexperienced physics graduate students and postdoctoral researchers lecture hundreds of students but stop intermittently to quiz and give feedback on the students' understanding of key concepts.

Whatever method a faculty member attempts, Mr. Wieman says, he or she should start by defining the underlying concepts to be taught and the learning outcomes that will be demonstrated. And it is not enough, he says, to simply declare that the learning outcome is to cover the first four chapters of a textbook.

"It's a whole different paradigm of teaching," says Mr. Wieman, likening the professor's role to that of a cognitive coach. "A good coach figures out what makes a great athlete and what practice helps you achieve that. They motivate the learner to put out intense effort, and they provide expert feedback that's very timely."

Published February 19, 2012
http://www.chronicle.com/article/How-Flipping-the-Classroom/130857/

Inside the Flipped Classroom

By KATHERINE MANGAN

GEORGETOWN, TEX.

Sara Infante listens intently and scribbles notes as her chemistry professor describes how to identify the masses and atomic numbers of two isotopes of carbon. When it's time to fill in a table showing that she understands the lecture so far, she clicks her mouse, and the lecture, which is being delivered online, freezes on the computer screen.

The questions that Ms. Infante and her classmates at Southwestern University ask their professor, Maha Zewail-Foote, will help shape the next day's session in the classroom. There, moving on to more-complex topics, she'll help them tackle the kinds of problems that used to be given as homework.

It's Ms. Infante's first experience with the flipped classroom, where traditional classwork is done at home and homework is done in class.

"I like this because when you're listening to the lecture at home and you don't get something, you can rewind and replay it as many times as you need to," says Ms. Infante, 19, a sophomore majoring in animal behavior who hopes to become a marine-mammal trainer.

"And when you're working through problems," she adds, "you aren't sitting in your room pulling your hair out because you didn't retain the information from the lecture."

The video for the semester's first flipped class, with its accompanying tables and diagrams, lasted just under 10 minutes. They're usually five to seven minutes, which Ms. Zewail-Foote describes as the attention span of most students. But in her opinion, a well-crafted, concise, 10-minute video that students can pause and replay as many times as they want packs more teaching in than a 20-minute lecture.

The course Web site include outlines that students fill in while they're listening to her recorded lessons, each of which ends with a short quiz.

"Between the lecture outline and video, they should come to class ready," Ms. Zewail-Foote says. "They understand how to calculate average atomic mass, so we can jump right in."

At colleges nationwide, more and more professors are inverting homework and classwork this way, using technology to give students a head start on classroom sessions where they can be active participants and not just listeners.

THE TAKEAWAY

The flipped format changes the role of professor from "sage on the stage" to "guide on the side."

The flipped classroom is not for everyone. Many students feel lost without a traditional lecture to get them started, and some instructors are reluctant to give up the podium for a role on the sidelines, says Carol A. Twigg, president of the National Center for Academic Transformation.

Since 1999 the center has helped redesign about 300 courses on 159 campuses, often in a flipped format, using technology to cut costs and improve learning. (Southwestern did not work with the center on the revamped chemistry course, but it did consult with other proponents of the technique, as part of a project, supported by the Howard Hughes Medical Institute, aimed at making Southwestern's science curriculum more hands-on.)

Many of the national center's course redesigns have been in remedial math, financed by $2.2-million from the Bill & Melinda Gates Foundation. The center has also helped flip courses in subjects as diverse as Spanish, psychology, nutrition, and anatomy.

"The traditional classroom typically consists of a lecture of some kind where students are listening or watching the professor," Ms. Twigg says. "Then they do the hard work, solving problems, on their own. The notion is, flip that experience so the professor can help students when they need the help."

Switching from the role of "sage on the stage" to "guide on the side" requires a professional and cultural shift that many faculty members resist, she says. "It's easier to stand up and give the same lecture you've been giving for 20 years than it is to rethink your course, come up with new activities, and really engage your students."

The problem-solving and personalized interaction that take place face-to-face sets these classes apart from massive open online courses, or MOOCs, which too often consist mainly of recorded talks, she says, explaining that flipping the classroom requires more than simply moving lectures online.

Teaching to the masses is tempting, but it's not the same as offering a flipped course, she says. "Let's say I am the most brilliant lecturer of intelligent design, and now I'll have an audience of 200,000 instead of 200.

"The problem is, the success rates are awful," she adds, in a not-so-subtle jab at Sebastian Thrun, the former Stanford University professor who co-founded the MOOC platform Udacity last year, after his online "Introduction to Artificial Intelligence" course attracted more than 160,000 students worldwide. About 23,000 of those students completed the course.

While MOOCs can be effective at delivering content, flipped classrooms make students active participants in their education, says Southwestern's new president, Edward B. Burger. The former mathematics professor at Williams College has created more than 3,000 instructional CD-ROMS and videos in math that are used in classrooms from kindergarten through college. Instead of having students struggle to figure out problems in their dorm rooms at 2 a.m., he says, "I want to be there when students hit those roadblocks."

Although he didn't call it a flipped classroom at the time, Mr. Burger cultivated the technique of "inverting the roles of homework and classwork," an approach that contributed to his winning a national teaching award in 2010.

Back in the common room of her dormitory suite at Southwestern, Ms. Infante has finished listening to the online lecture and asks her roommate, who's curled up in an armchair across the room, for a scientific calculator so she can take the quiz.

Her roommate's own chemistry professor, Emily Niemeyer, offers the format once a week, on what she calls "flipped Fridays."

Ms. Infante aces the quiz and doesn't have any questions for her professor. Other students were stumped by a few questions, Ms. Zewail-Foote notes the following morning as she prepares for class. One student asked: "Will there ever be a time when an atom is not neutral and the number of protons and electrons don't balance each other out?"

The explanation would normally come up in Chapter 4, but Ms. Zewail-Foote decides to work the answer into today's classroom problem-solving session. Reviewing the quiz results, she can tell that students generally understand the material, so she is comfortable accelerating the pace a bit.

There's little danger that students are going to nod off in her class, because she peppers it with questions that they must answer using their hand-held clickers. If 29 students have clicked their answers, she pauses before moving on until all 30 have weighed in.

Shortly after the class begins, students cluster their desks into groups of three or four to work on problems as she walks around, occasionally crouching next to those who seem stuck.

When the semester's first flipped-classroom session is over, at least one student isn't yet sold. "I'm going to fail this class," says Alex Petrucci, a 20-year-old sophomore. The pre-class video didn't adequately prepare her for the problems she was asked to solve in class, she complains, and even with a cluster of classmates to confer with, she felt lost.

That kind of reaction isn't uncommon when classes are flipped.

An aeronautics-engineering professor at Mississippi State University who taught a course in statics, in a flipped format, encountered similar resistance from some students who couldn't get used to online lectures.

Masoud ais-Rohani, who worked with the National Center for Academic Transformation to revamp the statics course, says having students watch videos, take quizzes, and reflect on what they learned before each class session made it possible to spend class time doing hands-on projects that the course had never before had room for, like working with physical models of bridges and calculating the loads they can carry.

Nevertheless, the flipped format was put on hold for the statics course this year, after tests revealed that learning outcomes were about the same in the flipped classes, which cost the same, or slightly more, because of the extra tutors and teaching assistants required. In addition, students were grumbling.

"Some complained that the instructors were good, but they were wasted if they weren't standing in front of the class lecturing," says Pasquale Cinnella, head of the aerospace-engineering department.

If engineering enrollment continues to increase, and the classes become more cost-effective, Mr. Cinnella says, he may reinstate the flipped format.

Eventually, Mr. Rais-Rohani hopes to win over skeptics like the student who responded to his survey by saying: "If I am paying for a class and a professor to teach me, then I do not want to teach myself for homework and have homework for class."

In time, the professor hopes, more students will come around to agreeing with the student who found that the flipped format forced him to improve his study skills and take a more active role in his learning. "Now," that student wrote, "I'm responsible for my grade."

September 30, 2013
http://www.chronicle.com/article/Inside-the-Flipped-Classroom/141891/

It's a Flipping Revolution

By STEVEN NESHYBA

I was getting ready for the coming semester when out of the blue I got a call from my sister, a high-school chemistry teacher. She had "flipped" her chemistry class, and loved it. I should try it, she said. There was a note of conviction in her voice that was hard to ignore.

For those who haven't been paying attention, "flipping" is a teaching technique that involves abandoning the traditional lecture (or just not relying on it so much) and replacing it with interactive approaches that experiment with technology and require students to gather information outside of class and be prepared to engage the material in class, rather than sit passively listening to a faculty member talk.

So this semester in my chemistry courses (yes, the discipline runs in the family), I'm making videos about concepts like acid-base theory, uploading them onto YouTube, and using class time for interactive work. The in-class sessions are problem-based and often computational, so my videos range from "How do you 'fill down' in Excel?" to "What do antibonding orbitals looks like?" With less than a semester under my belt in flipping, I'm already a convert: I've never felt as effective or as efficient as this. But I think there is more afoot here than efficacy and efficiency.

I'm not talking about MOOCs. I'm talking about how technology, in tandem with innovations in pedagogy and the evolving nature of our students, is driving changes even at traditional private liberal-arts colleges like mine. Those changes were starting to become clear to me almost from the first week of the semester, and certainly by the first exam.

THE TAKEAWAY

Moving to a flipped model changes which kinds of students excel and which ones struggle.

For years now, the first exam in my general chemistry course has been brutal. About a third of the class usually fails it. Then I offer individual conferences, the essence of which is me telling students what I have told them forever, "You must take responsibility for your own education."

This year the exam went a little better than most. Only a quarter of the class failed. But some students did very well. One in particular, "Sam," scored an astonishing 97 percent. I'm not sure I would have done so well. He came in for a conference anyway, so I asked him: What's your secret? Did you take AP chemistry in high school or something? And it turns out, no, he hadn't.

Sam has an unconventional learning style. It's far more efficient for him to learn from online videos and Wikipedia than from texts and lecture notes. In my lecture-based course a year ago, he might have been struggling among the failing 30 percent. In a flipped classroom, he shines.

Another student, "Rolf," dropped by a little later. He had scored in the lower 30 percent. I asked if the problem was the weird way I've structured the course, with all the videos and hands-on activities.

"I am having trouble adjusting to the classroom lectures," he said.

What?

Rolf explained that in his high school, the entire curriculum used problem-based learning. He gets fidgety in a classroom lecture. But when the lectures are on video, that's altogether different: He can watch them as many times as he wants, and it doesn't matter if he fidgets.

So my first insight as a result of flipping my general chemistry course was this: The combination of technology and innovative pedagogical approaches emerging from high schools is mixing up who excels in college classrooms.

It took a little longer to get clued into the second insight. It's about how technology is also changing relationships in the classroom, which, in turn, is affecting what it means to excel.

One relationship shift is between professors and students. It has to do with who knows what. YouTube lets you track video usage, and I could see that after the first exam, the viewing numbers were down. The effects were confirmed in the next in-class exercise. So I sent this slightly aggressive e-mail out to the class:

"I couldn't help noticing that some of you came to last week's Thursday/Friday session with little or no preparation and consequently did not benefit very much from the exercise. This observation is consistent with the fact that about a third of you didn't watch the video, 'Computational video 1 Preparation for the MO computation.' It is your education, of course, and you are free to manage your time as you see fit; I just want to be sure you understand that putting class preparation at the low end of your priority list in the hope of making up that time later is a suboptimal strategy."

But once I knew that students couldn't be bothered to watch a five-minute video before class, I couldn't unknow it.

Mortified, Sam fired back, "Is that a general e-mail or is it just for me? Because if it's just for me, I take great offense at the accusation."

I guess I deserved that.

But once I knew that students couldn't be bothered to watch a five-minute video before class, I couldn't unknow it. And once they knew that I knew, they (or at least Sam) had to make some decisions. My relationship with my students had been changed by technology, and the outcome of that change was a greater sense of ownership on the part of students.

I believe that deeper professor-student shifts are in store for us. It's not controversial to say that the Web has significantly eroded the special claim that professors have as unique repositories of knowledge. That doesn't mean we're useless in the classroom. Quite the opposite, in fact. "It's not about memorizing the structure of the periodic table," I tell my students these days, "because that's all on Wikipedia. It's about communicating to me that you can solve problems. Because the world has a lot of problems." In short, the information age makes it easier to make it clear to students that the central pillar of their college education is what we have always believed it to be: their responsibility.

Finally, there are relationship shifts among students themselves. One has to do with the inclusion and acceptance of a greater diversity of learning styles in the classroom. This year I have special insight into this because my daughter is a freshman at another small private liberal-arts college. She has permitted me to meet her friends. Her roommate, Mary, has a lab partner, Martina, who is dyslexic. Martina uses electronic text readers that allow her to process laboratory handouts. Then she and Mary discuss them at length—they explain, articulate, argue, and listen. Those critical communication skills are notoriously hard to "teach," but here at the intersection of technology and diversity, they have arisen spontaneously, as a matter of necessity.

Of course, those shifts are not the result of flipping alone. They're happening because of Wikipedia, integrated high-school classrooms, and innovative high-school teachers who know how to bring out the best in their kids (and who have led the flipping revolution).

Maybe that's the shape of the future. Parents send their kids to college because it is a place their (possibly brilliant) teenagers might not merely survive but discover new routes to a 97 percent on killer exams, or find the courage to call out aggressions (even if it's a professor who commits them), or to learn how to think, argue, explain, listen, and get chalk on their hands. All of which is high-octane liberal-arts education, desperately needed in the very challenging world these students will soon face.

As for me, I just hope I'm ready for my sister's next phone call.

Steven Neshyba is a professor of chemistry at the University of Puget Sound.

April 4, 2013
http://www.chronicle.com/article/Its-a-Flipping-Revolution/138259/

Toward a Common Definition of 'Flipped Learning'

By ROBERT TALBERT

We've seen a significant ramping up of interest in – and exposure to – the flipped/inverted classroom over the last few years, and it's been nice to see an uptick in the amount of research being done into its effectiveness. But one thing that's been lacking has been a consensus on what the flipped classroom actually *is*. If a professor assigns readings to do before class and then holds discussions in class, is that "the flipped classroom"? I've said in the past that it is not (necessarily), but that's just me. Now, however, a group of educators and others interested in flipped learning are proposing a common definition of flipped learning, and it's pretty interesting.

Their definition of flipped learning goes like this:

> *Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, 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.*

Note first that the authors are not defining what the *flipped classroom* is but rather what *flipped learning* is. They say: "These terms are not interchangeable. Flipping a class can, but does not necessarily, lead to Flipped Learning." I think that's right. The flipped classroom describes a logistical arrangement – how and when the initial information is encountered by students, what is scheduled to happen in class – whereas flipped learning focuses on the processes that students engage in and the outcomes they strive towards within that logistical framework. Many "flipped classes" are indistinguishable from traditional lecture courses in terms of what students *do*.

So, what does flipped learning involve that distinguishes it from merely flipping a classroom? The authors lay out four "pillars" of practice, conveniently chosen to form FLIP as an acronym:

THE TAKEAWAY

Educators argue that flipped learning involves four pillars: flexible learning environments, student-centered classrooms, just-in-time content, and more-intentional instruction.

- **Flexible environment** (Students are allowed a variety of modes of learning and means of assessment)
- **Learning culture** (Student-centered communities of inquiry rather than instructor-centered lecture)
- **Intentional content** (Basically this means placing content in the most appropriate context – direct instruction prior to class for individual use, video that's accessible to all students, etc.)
- **Professional educator** (Being a reflective, accessible instructor who collaborates with other educators and takes responsibility for perfecting one's craft)

There's even a checklist next to each "pillar" to assess how well you're doing in each one.

What the authors have done here, I think, really distinguishes the inverted classroom as I understand it—a way of designing courses that emphasizes self-regulated learning and deep learning on a personal level—from classes that say they are flipped but don't take advantage of the opportunities for student learning that flipping offers. Just because you've been giving reading assignments outside of class and holding discussions in class, it doesn't mean you've "always been flipping the classroom". There's more at work, and at stake here. The focus in the above definition is on student learning and not on course design and I think that's totally correct.

I do think the definition in this document should say something about the eventual goals of flipped learning. What kind of students do we want to create through their experiences with flipped learning? For me, self-regulated learning is both the motivation for flipped learning as well as its ultimate goal. All four of the pillars here sort of bear upon this, but if I were editing this document, I would throw in something about what the long-term product of flipped learning should be. That product would be a generation of learners who are confident, competent problem-solvers who have the abilities and the desire to learn new things on their own, throughout their lives.

In ticking down through the lists, I think the item I need to work on the most is the "flexible environment". Right now students all demonstrate their learning in my classes more or less the same way – homework (or labs), tests, and a final exam. My classes right now (cryptography, and discrete structures) also have projects, and so there is a lot of choice with those. But not much choice elsewhere. I had already been eyeing standards-based grading before seeing this document and moreso now, possibly to try out this fall when I teach version 2.0 of the flipped calculus course.

Robert Talbert is a mathematician and educator at Grand Valley State University.

April 1, 2014
http://www.chronicle.com/blognetwork/castingoutnines/2014/04/01/toward-a-common-definition-of-flipped-learning/

Flipped Learning Skepticism: Do Students Want to Have Lectures?

By ROBERT TALBERT

THE TAKEAWAY

Many students in flipped classrooms are rebelling because they want professors to lecture to them and tell them exactly how to earn a good grade.

This article continues a look at some of the skepticisms I've seen about flipped learning and the flipped classroom. Previously, we discussed whether flipped learning means having students learn everything on their own and whether students can even learn on their own in the first place.

This time I want to focus on an issue that was the third point in a good comment from a previous post about flipped learning. In that post, I was reporting about a framework for defining what flipped learning is. The authors of that framework laid out four "pillars of practice" for the flipped classroom, one of which was the creation of a learning culture—student-centered communities of inquiry instead of instructor-centered lectures. The comment on that was:

> *As far as creating a "learning culture"? Again, this was more possible when I worked at a 4 year school. It is possible to some extent, but in my developmental courses, I am trying to teach both content and thinking strategies. I have to teach students how to think critically before I can create a learning culture… and they fight me every step of the way. They really just want to have me tell them everything so they can study in the traditional way and get an A (or in the case of developmental, a P).*

I have a great deal of sympathy with this because my first experience with running a flipped classroom was characterized by conflict. So was the second experience (same class, subsequent year). And even today I still get a nontrivial amount of pushback from students in a flipped classroom setting, usually for the same reasons.

Before I say anything else about this, I want to make two points clear:

- **Student resistance to a particular idea about course design or teaching does**

not mean that the idea itself is bad. It just means that students are uncomfortable and are trying to figure out what the rules are, and this manifests itself some times in conflict. The issue brought up in the comment, in other words, isn't really a skepticism about flipped learning per se so much as a concern about getting it to work. For those who are skeptical about flipped learning because you're convinced it will never work, keep reading:

- **Student resistance does not have to be permanent even if it's widespread.** I've found that students can change their minds about this, and it's not because my students are any smarter or more mature than anybody else's. This isn't about intelligence or maturity but about communication.

Having said that, let's deal with the issue: **Students in a flipped classroom are rebelling because they want you to lecture to them and tell how to do everything so that they can earn a top grade in the class.** Here are some responses to this issue that one could make. I would caution, though, as I wrote in this post that you should avoid getting into a public debate about your teaching choices—keep it private and one-on-one if possible, using public forums instead to present a positive message and to celebrate student successes.

First: It's interesting that students might have complaints about a lack of lecturing, because many flipped classrooms have tons of lecture in them. For example, my flipped transition-to-proof class has 107 video lectures available for students, and more can be added on demand. Those lectures contain the exact same content as they would have if I were delivering them in class—and they're better, because they've been edited. There is absolutely a lot of lecture going on in that course—just not during class meetings.

So unless you've specifically stuctured the class otherwise, it's simply not the case that you are not giving direct instruction. It's just that direct instruction in the form of a mass-transmitted lecture isn't the focus of the class meeting any more. And why should it be? Which is harder, hearing about something or doing something? And if doing something is harder than hearing, wouldn't students want to do their work with an instructor and a group of friends present to help, rather than hear about it with the instructor present and then be left to their own devices for the doing part? Wouldn't it be better if you were doing the hardest part of the work when I am most likely to be able to help you?

I've found the above to be an effective counter to the student complaint that they are not being shown how to do things. It's not factually true, for starters—but in fact it's usually not even the real issue. Read on.

Second: Students want to earn a top grade in the class. Great! We'd like for them to be successul too. But of course the sticking point is the definition of "success". As instructors, we're looking out for students' success in the long term. Getting an A (or "P", etc.) in the current course is not a success if they forget everything they learned after the final exam and lack the problem-solving skills to move forward in the next class or in their careers.

We can help students understand this point by making our definition of "success" normative in the course—by way of the learning objectives we choose and the kinds of assessments we give.

I've written a lot about learning objectives. While the learning experience is more than just the sum total of the class' learning objectives, it's important to decide carefully what we are going to assess and then make those items clear to students. If you want to have a class with a stronger emphasis on process, then include process-oriented goals in your learning objectives and discuss those objectives with the students—and discuss *why* they are objectives. It sends a message when student see, on the list of objectives that the upcoming test is covering, a number of objectives that are higher up Bloom's Taxonomy than just making calculations. If students don't see *any* objectives, then they'll default to what they think those objectives ought to be, which is 100% calculations just like those that were in the homework and the lecture. The instructor has the necessary job of setting the agenda.

Then, having made those learning objectives, it's our job to give assessments that truly measure what we want to see. If you only ever assess basic rote mechanics in a math course, then *the course is about rote mechanics*—regardless of the instructor's intentions. And by "assessment", I would encourage folks to think of other ways of assessing students besides timed quizzes and tests — methods like clicker questions, Guided Practice assignments, application projects, and so on. If the only assessments we have are tests and quizzes, then students will focus on tests and quizzes and nothing else. Balance is needed if we want more.

Third: There's an interesting thread in this kind of student reaction that combines where students have come from in their mathematical education and where they think they are headed. I said above that the lack of lecturing isn't usually the real issue with students—mainly because there's no factual basis for it. Instead, I think the issue is *uncertainty*. Students have made it to where they are, mathematically speaking, because they've acclimatized to the lecture model. Changing this model violates their expectations and introduces a lot of uncertainty—and conflict can be a coping mechanism.

There are a couple of things that an instructor could say to a student who is feeling this uncertainty.

If the student is in a remedial mathematics course, you can simply ask: **So, you're used to having the instructor show you what to do, and then you do it. How is this working out for you?** This isn't snark (or at least it shouldn't be) but rather an honest question about the effectiveness of the teaching method that the student is clinging to.

If the student is in a non-remedial course, you can ask: **Let's look beyond this class for a minute and think about what you'd like to be doing five, ten years from now. How does a person who does the same things, become successful?** For example, say the student is an engineering major. What does a successful engineer do, and how does she get that way? Or what about a doctor? Or a stay-at-home mom? Or an electrician? If the student doesn't really have a clear idea about the answer to that question, it would be a good exercise to have the student go do some web research or talk to other professors to find out. And once they do have an idea, what ought to be clear is that *just having someone tell you what to write on a test isn't enough*. And since we want students to be successful, operating a class in such a way isn't enough, either.

This doesn't necessarily eliminate students' uncertainties or discomfort, but it at least puts it in perspective. We want students to be successful. (Do we *tell* this to students often enough?) And that means equipping them for what life will demand of them, which is not a laundry list of content. That's why the class is designed the way that it is.

I want to encourage anyone in this situation not to give up hope and not to beat a hasty retreat. In fact your students, if they are acting like this, are *exactly where you want them*. They are primed to learn something about learning, and about the value of learning versus the value of grades. Conflict stinks, but this is a pretty exciting moment if you're an educator.

Robert Talbert is a mathematician and educator at Grand Valley State University.

May 5, 2014
http://www.chronicle.com/blognetwork/castingoutnines/2014/05/05/flipped-learning-skepticism-do-students-want-to-have-lectures/

Physicists Eagerly Try New Teaching Methods but Often Drop Them, Study Finds

By DAN BERRETT

Most physics professors have heard of and tried a teaching method beyond the traditional lecture, but one-third of those who have sampled such a technique later abandoned it, according to a new study

"The surprising thing we found was the high rate of faculty willing to try these things," said Charles R. Henderson, an associate professor of physics at Western Michigan University and the lead author of "Use of Research-Based Instructional Strategies in Introductory Physics," which was published in the current issue of *Physical Review Special Topics—Physics Education Research*

About 88 percent of the physics faculty in the study knew about "research-based instructional strategies." Of that group, 82 percent had tried the strategies, wrote Mr. Henderson and his co-authors, Melissa H. Dancy, a physics-education researcher at the University of Colorado at Boulder, and Magdalena Niewiadomska-Bugaj, chair of the statistics department at Western Michigan.

The researchers conducted a Web-based survey of 722 faculty members in physics, a discipline that, among the sciences, is often thought to be at the forefront of trying new pedagogies. The sample included faculty at two types of four-year colleges—those that offer graduate degrees in physics and those that do not—as well as at two-year colleges. The survey asked whether the faculty members knew about those strategies, whether they had tried them (and how many), and if they continued to do so.

The researchers listed 24 strategies, each of which seeks to prod students to participate in class more actively than tends to happen in a traditional lecture. The strategies include peer instruction, interactive lecture demonstrations, cooperative group problem solving, and just-in-time teaching. Many of the techniques fall under the general category of the "flipped" classroom, where students learn the material largely outside of class and spend some portion of class time solving problems with their professors or peers,

THE TAKEAWAY

Awareness of alternative classroom methods isn't the problem. The bigger challenge is supporting professors who experiment and often face pushback from students.

and applying what they learn to new contexts. Prior research on those methods, the authors wrote, demonstrates that "student conceptual understanding of core physics topics is significantly and consistently higher in courses using active-engagement methods compared to courses using traditional, lecture-based methods."

Unprepared for Problems

While active-engagement methods may be more effective, they can also be difficult to sustain, the authors found. One out of three of the respondents who had tried those methods later reverted to lecturing.

Their reasons for dropping those methods are still unclear, though Mr. Henderson and Ms. Dancy are conducting follow-up research on the subject. Some faculty members may need help modifying the new methods for their classrooms, Mr. Henderson said.

They also may not be prepared for the intensity of complaints from students, some of whom find the methods unfamiliar and, because of their emphasis on peer learning, less driven by faculty expertise. "They don't expect to run into problems," he said of professors. "When it does happen, they're really unprepared for them."

His research suggests that awareness of different teaching methods is not the problem, Mr. Henderson said. Those who advocate such active methods could be more frank in describing the difficulties of using them, he said, and faculty members should have more resources available to help them.

A willingness to try different methods is widespread, Mr. Henderson said. While conventional wisdom holds that older professors or those with significant research responsibilities tend to have little appetite for changing their teaching methods, the authors found no evidence to support that notion.

Such results were particularly heartening to Eric Mazur, a professor of physics and applied physics at Harvard University, and a staunch advocate for peer instruction, which was the most popular strategy attempted, according to other studies by Mr. Henderson.

While he would rather have seen more professors sticking with the methods, Mr. Mazur saw the study's findings as evidence that the teaching of physics has begun to change quite widely.

"Education research has had a phenomenal impact," he said. "I like to look at the glass as two-thirds full."

August 31, 2012
http://www.chronicle.com/article/Physicists-Who-Flip-Their/134100/

When a Flipped-Classroom Pioneer Hands Off His Video Lectures, This Is What Happens

By JEFFREY R. YOUNG

In a way, there are two Norman Nemrows. There's the real-life professor who spent much of his career teaching accounting students at Brigham Young University. And there's the one I'll call Video Norm, the instructor immortalized in lectures on accounting that he began recording nearly 15 years ago.

For more than a decade, students at BYU learned from both Norms. About half of the class sessions for his introductory-accounting course were "software days," when students watched an hour or two of video lectures on their computers anywhere they wanted and then completed quizzes online. The other class periods were "enhancement lectures," in which students—as many as 800 at a time—gathered in a classroom and did group work led by the actual Mr. Nemrow.

Back when it started, in 2000, this method of reducing in-person classes and replacing them with videos and tutorials was an innovation, but today it is a buzzword: the flipped classroom.

Not long ago, the living, breathing Norman Nemrow retired from the university. And that's when things got interesting, or at least more complicated, because students at BYU still learn from Video Norm.

In fact, every student taking introductory accounting at the university watches the video lectures, some 3,000 students each year. And the in-person sessions? They're now led by another accounting professor, Melissa Larson, who has been thrust into the novel role of doing everything a traditional professor does except the lecturing. The tough question—and one of the biggest for the future of the flipped model—is whether other professors will be willing or able to become sidekicks to slick video productions.

Ms. Larson gets high marks on student evaluations for leading group work in the large classroom sessions and answering questions by email. But Video Norm remains the star.

That was clear when Mr. Nemrow showed up, in person, at the end of the fall semester to give a guest lecture for the introductory course. You'd think

THE TAKEAWAY

A tough question—and one of the biggest for the future of the flipped model—is whether professors will be willing or able to become sidekicks to slick video productions.

a Hollywood actor had come to campus. Students showed up early to take selfies with the professor they had spent so many hours watching on video.

"We got front-row seats," said Celeste Harris, a junior in the course. "We said, we have to see what this guy is like in real life."

How did Mr. Nemrow compare with the digital version? "He's a little older than when he recorded the videos," Ms. Harris notes, "but it was actually one of the best lectures I've heard." It was inspirational, she says, because Mr. Nemrow recounted the story of this unusual accounting course, which has become a kind of legend on campus.

From Business to Teaching

Mr. Nemrow started out as a businessman. He worked at a consulting firm in California, then helped start a real-estate-investment firm. But he was drawn to the classroom. For years he taught accounting on the side, first as an adjunct at California State University at Fullerton, then full time at Pepperdine University.

Around the time he turned 30, he sold his business and decided to retire early. He didn't want to do nothing, but he no longer had to work for money, he says, even with a wife and five small children.

"I didn't really have a burning desire to create another business," he says. He took some art classes. He played a lot of golf. "For a couple of years I was trying to kind of find myself," he recalls. "I decided what I really wanted to do is probably teach."

So he called up the dean of the business school at his alma mater, Brigham Young, and asked if there was a teaching spot for him. He had a master's degree but not a Ph.D., and at first the answer was no. "When I told him I was willing to do it as a volunteer, his attitude changed," Mr. Nemrow recounts, with a laugh. "He let me teach the intro course for a year."

BYU hired Mr. Nemrow as a full-time professor. He donated his salary to the university, he says. A devout Mormon, he saw the work as a way to give back to the church. In his mind, that left his teaching in the category of volunteer work. "I wanted to have complete and total freedom, and I didn't want to make a commitment to how long I'd be there."

After several years of teaching the introductory course, he says, he began to get tired of repeating himself and answering the same questions. He considered writing a textbook and even drafted a couple of chapters. "But I thought to myself, this isn't as effective as when I'm explaining it in person."

So, in 1998, he approached the university's fledgling instructional-technology group and pitched his idea to reformat his course around a series of videos and computerized homework assignments. "They were worried about getting funding, so I just put up the money myself," about $50,000, he says.

After two years of development and some lobbying to convince the accounting faculty to let him try his flipped experiment, Video Norm was born.

Mr. Nemrow says the software increased the number of students he could teach at one time, while reducing the time it took him to do it. And he says his surveys showed that 93 percent of his students reported learning more effectively from the flipped format than from a traditional one. Both his inner businessman and his inner philanthropist thought: This is going to be big.

Hitting the Road

Mr. Nemrow believed that his system was simply better than the old way, and he thought that once other accounting professors saw it, they'd immediately adopt his videos and software rather than the textbook-and-lecture method.

He started a company, Business Learning Software Inc., to manage and update the videos and the delivery technology. True to his desire to keep his teaching like volunteer work, he says, he donates any profits to charities. Because the software and videos were developed at BYU, the university owns it and gets a portion of any revenue from its sale. And he made all of the videos for his intro course available free online.

Mr. Nemrow traveled to accounting departments and academic conferences around the country evangelizing his teaching approach and his software. But, to his surprise, he found few takers.

"When I talked to faculty, their eyeballs got big, but it wasn't excitement—they were scared to death," he says. Only a handful of professors tried it, but "all the rest of them saw it as threatening to their careers, and to the way they were teaching."

Mark H. Taylor was one of the few professors immediately excited by the idea. And his experience shows that professors were right to worry about their roles' changing. At the time, Mr. Taylor was at Creighton University, and he tried the flipped approach in a course with 40 introductory-accounting students. "The students at Creighton did not bond to me, they bonded to him," he says, meaning to Video Norm. "I wasn't really doing the instructing."

The experiment itself was a success, Mr. Taylor says. The students benefited from being able to rewind the lectures and review anything they didn't initially understand. They also liked that they could play the lectures at double speed (something students at BYU typically do as well).

But he says he missed the feeling of connection with his students. "It was more of a pride thing on my part than any real problem with using these videos. I think some professors, including myself, love that lecture time." And in the flipped model, he felt, students were less willing to come to his office and ask questions.

'It's a Bit Tricky'

That was in 2007. Today Mr. Taylor chairs the accounting department at Case Western Reserve University, and he's thinking of trying the flipped approach again, believing that the flexibility the videos give students outweighs his own feelings.

The chair of the School of Accountancy at BYU, Jeff Wilks, agrees that flipping a classroom with someone else's materials isn't for everyone: "It takes a certain kind of professor to be in front of this big of a class and not be bugged by the fact that a lot of the teaching is going on outside the class by someone who isn't you."

Ms. Larson, the classroom professor at BYU, says her changed role has taken some getting used to, and requires her to maintain a deep familiarity with Video Norm. "It is a bit tricky, because you have to watch Norm's stuff and you have to bridge it" in classroom demonstrations.

But if Ms. Larson feels like a supporting cast member at times, she says she may soon move into a starring role, if a planned update of the lectures goes forward: "I'll be the face on the new ones." Already she is recording what she refers to as "pencasts," short videos of her working through each homework problem, which students can watch if they get stuck.

"Some people say they feel like they had two professors," Ms. Larson says.

But Mr. Nemrow is the figure who has become larger than life. One year BYU students designed T-shirts emblazoned with his face and the words "Norm is Watching." "I rarely go anywhere in Utah where I am not recognized by former students," he says. "They usually want to thank me for the software and talk about the course and life in general."

He understands the concerns of professors who prefer teaching the basic concepts themselves. "To be perfectly honest," he admits, "I probably would have had trouble turning my students over to a product like mine made by someone else."

January 7, 2015
http://www.chronicle.com/article/Why-Academics-Stink-at/151031/

Resources

The use of the flipped model appears to be growing, and so is the body of research on its effectiveness. New insights are emerging. Here are a few resources to ground your own experiments.

"Interactive Engagement vs. Traditional Methods: A Six-Thousand-Student Survey of Mechanics Test Data for Introductory Physics Courses," by Richard R. Hake, 1998
http://web.mit.edu/jbelcher/www/TEALref/hake.pdf

"Active Learning Increases Student Performance in Science, Engineering, and Mathematics," by Scott Freeman, et al., 2014
http://www.pnas.org/content/111/23/8410.abstract

"Peer Instruction: Engaging Students One-on-One, All at Once," by Catherine H. Crouch, et al., 2007
http://www.compadre.org/Repository/document/ServeFile.cfm?ID=4990&DocID=241&DocFID=273&Attachment=1

"Evidence for the Efficacy of Student-Active Learning Pedagogies," by Jeffrey E. Froyd, 2007
http://www.pkal.org/documents/BibliographyofSALPedagogies.cfm

"Flipped Classrooms: Annotated List of Resources," by Phil Hill, 2014
http://mfeldstein.com/flipped-classrooms-annotated-list-resources/