nudge education

Technology for people who transform education

The Externally Flipped Classroom

Advances in technology have made it possible to completely rethink the classroom structure that has prevailed in American education for generations. In this chapter we describe the general nature and the role of technology in one of the first steps in this restructuring: the flipped classroom.

This is not to say that all flipped classrooms operate identically. Teachers have found many ways to flip classrooms, which has produced many classification schemes to try to make sense of all of these approaches. In this chapter we do not intend to create a new taxonomy of flipped classrooms, rather we discuss the role of technology in one particular aspect of flipped classrooms that applies to all types, how information crosses the boundary of the classroom.

What is a flipped classroom?

A flipped classroom reverses the order of traditional teaching. Students learn content outside of the classroom and inside the classroom they work on tasks that had been "homework." Their work at home becomes learning the content, and their work in the classroom becomes practicing and internalizing the content: lectures at home and assignments in school.

Flipped classrooms have many benefits. Students can take as long as they need to at home to learn the content. Some students will watch a lecture video once and understand. Others can stop, rewind, replay and repeat until the content is more clear. Also, this frees up class time for the teacher to facilitate hands-on learning, group activities and follow-up questions. The flipped classroom model restructures the existing classroom and, when executed well in certain circumstances, can offer great benefits to students and teachers.

This practice has been especially appealing to teachers who like project based learning and support students teaching each other. Teachers trying to transfer the responsibility of learning to the students, wanting to be less of the gatekeeper of information and more of the

facilitator and encourager of learning tend to be drawn to the idea of the flip.

All flipped classrooms change the proportion of how time is spent in the classroom and at home, but they do not fundamentally change the boundaries of the classroom or how information crosses those boundaries. The students and teacher that comprise a class still exchange the same information with each other, but at different times. The teacher remains the gatekeeper to the information and simply disseminates that information to the students via videos instead of in class lectures. All the changes that the first attempts at flipped classrooms make occur within the boundaries of that learning group, so we refer to these first attempts at flipped classrooms as "internally flipped classrooms."

The role of technology in an internally flipped classroom

Technology that allows for flipping a classroom acts as amplification in the RAT framework. All of the same activities happen, but technology allows them to happen more efficiently. The educational activities influenced by video recording and sharing technology include direct instruction (lecture), discussion, guided practice, and individual practice. These processes exist in a non-flipped classroom: direct instruction will occupy much of the time the students and the teacher spend together, and discussion and guided practice will occupy much of the rest, while solo practice takes place outside of class hours. Flipped classrooms change the proportion and the timing of these activities, but they do not necessarily change the nature of what comprises the students' education experiences. Moving the direct instruction to outside of class hours frees up time for discussion and guided practice, but all of the same pieces still take place.

In this traditional construction of the classroom, the common complaint of the student, "You never taught us that!" may at times have been true.

Flipping a classroom is technically possible in the absence of video sharing technology, though video sharing technology makes the process immeasurably better. A teacher could write a book for the students to read, require that they read it, and spend class time on activities other than direct instruction. Experience indicates that this strategy would not work very well, and would work much worse for some students than other students. Many students would agree that watching targeted videos is a more enjoyable and more effective way to learn compared with reading a targeted book, but a paper based flipped classroom is still possible nonetheless. Because internally flipped classrooms use technology to accomplish something that was theoretically possible before that technology existed--though it is much better and easier now--we categorize the technology behind modern internally flipped classrooms as amplification, and not transformational.

Externally flipped classrooms

Classrooms can be flipped in another way. Many teachers who were drawn to the idea of the flipped classroom end up getting frustrated because they were hoping for transformation and over time only experience amplification. Having more time for in-class activities and discussion is good, but creating all the lecture videos is time-consuming, and ultimately the students do not own their education experience any more than they did with the unflipped classroom. Teachers striving for transformation are starting to experiment with the next iteration--the externally flipped classroom.

Thirty years ago, a classroom full of students relied on their teacher for all of their content needs. In a physics class, for example, the teacher held the physics, and most students could not count on another source of physics knowledge--their textbook being the primary possible exception. The teacher could give (or not give) information about physics to the student to the extent of their inclination and ability. This role made the teacher very powerful in the classroom: the teacher could define what physics is and isn't through the creation of direct instruction, and the teacher had ultimate control over deciding which students in the class did and didn't know physics by giving scores on exams and assignments. In this traditional construction of the classroom, the common complaint of the student, "You never taught us that!" may at times have been true.

The internet has changed one important aspect of this scenario: the internet now allows students access to vast collections of information. Through the internet students can receive knowledge from many people who, to continue the example from above, hold the physics. MOOCs, teachers' publicly available personal YouTube channels, a whole array of video series created by for- and non-profit education services, and other sources all contain complete, thoughtfully delivered content for many subjects. Teachers no longer need to hold the content for the classes they teach; teachers can send students into the wide world to find sources of content that suits them well. Flipping a classroom externally leads to meaningful changes in the boundaries of the learning group. Students in externally flipped classrooms do not rely on entities within the class (i.e., the teacher) for direct input; rather direct input comes from outside the classroom.

The most important idea to keep in mind is that successfully flipping a class is a cultural endeavor.

In externally flipped classrooms, teachers have different power and students have more power. The teacher structures the class, sets the timeline, manages assessments, and helps students learn, but does not provide direct instruction. Teachers should think carefully about how narrowly they specify resources for the externally flipped classroom. Selecting resources for direct

instruction should be a shared activity between teachers and students--if teachers maintain too much control over what external resources the students will use they both withhold that power from students and students will not receive the benefits of customizing their sources of information.

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Harnessing the power of the internet can seem daunting, or even threatening. Some teachers may not appreciate how much information their students can access, some may worry about what lurks out in the wide online world, and still others see losing their position as content-holder as threatening to their identity as a teacher. But some aspects of the teacher's position in the traditional classroom structure have not changed: teachers have not stepped out of the role of content expert, teachers remain leaders in the classroom, and teachers' roles as experts about learners and learning becomes even more vital.

In the traditional classroom, the teacher picks the curriculum, teaches it and evaluates it. The teacher realistically only has time to teach and evaluate the content one way, or at most in a few ways. If that way does not work for the student, he or she is bound to struggle. This has had an effect on who excels in class, and benefits those students most similar to the teacher. Allowing all students to learn the content in a manner that suits them helps the students who are less like the teacher access the material, and generally evens the playing field. Unfortunately, we know of no research about the impact of using technology to intentionally transfer power to students on the achievement gap, but the potential of this practice to help students from all cultural backgrounds excel is encouraging.

A side note about economics

On any given day, thousands of teachers say the exact same thing about a given topic. They may describe the idea in different ways, but they endeavor to describe the same idea. Consider the area of a parallelogram. If every student receives direct instruction on this idea once during their lives, we can assume that four million students in the US learn about the area of a parallelogram every year. If we assume an average class size of 25 students, then 160,000 classrooms participate in this direct instruction. If each occurrence of this direct instruction takes 20 minutes, then the US economy dedicates more than 53,000 hours per year to explaining the exact same thing--that's almost 27 full-time employees for just one idea. If we assume that students learn 100 ideas in each of 5 classes per year for 16 years, that means that adults in the US unnecessarily duplicate almost 430,000,000 hours of work, or more than 210,000 full-time equivalent positions. These assumptions are all simplistic approximations, but something in the

neighborhood of 200,000 jobs represents a huge amount of productivity that could be better applied. Imagine the benefits we would realize if American teachers spent those 430 million hours counseling, tutoring, coaching, and offering advice to their students. In addition to the educational benefits of externally flipped classrooms, they allow the US economy to use its workforce much more efficiently. If you currently work as a teacher, wonder about this next time you introduce material to your students: how many other people will say pretty much the same thing as you today?

What to expect in an externally flipped classroom

A few years ago, I decided to flip my AP Physics classroom, and I wanted to leverage existing technology as much as possible. At our high school, the AP Physics students were accustomed to a traditional classroom. Their previous teachers held the information and handed it over via lectures in class. The students then used the textbook to complete problem sets at home to prepare for the exams. Class time was divided among three activities: the great majority of class time went to direct instruction (lecture). Laboratory experiments received the next biggest piece of the pie. Lastly, assessments in the form of exams occupied the remaining time. The students would complete homework, write lab reports, and undertake their own studying at home.

My AP Physics students were experts at playing the traditional classroom game: many of them can learn as fast as their teacher can talk.

In my externally flipped classroom, I offer direct instruction about 10% of the time, and during that time I cover about 5% of the material. I give my students a brief outline of the topic and warn them about some of the difficult concepts, and they go and learn the material. The tasks of my job then become addressing specific frustrations, keeping up the class calendar and other structural pieces, and conducting assessments. Creating assessments and helping the students interpret the results of those assessments has become an increasingly large and surprisingly different part of my role in the classroom. The most obvious, but least important, reason for this is because I can spend time on assessments that I previously had to spend on preparing and administering instruction. The more important reason why assessments have become a larger part of my job is because evaluation is primarily where the students and I interact with the material together. My ability to explain physics has a reduced instructional role in an externally flipped classroom; instead I use my training and experience to help my students figure out where they stand with respect to understanding physics in the same way as the rest of the scientific world. This role is less adversarial. Instead of giving students tests to determine if they learned the physics that I taught them, I give them tests to help them

determine if they understand physics like the scientific community says they should.

The initial weeks in an externally flipped classroom require some adjustment of expectations on the part of the students; most of them fight it. My students wanted to proceed as they had in the past. They wanted me to tell them what they needed to know so that they could turn around and prove to me that they knew it on tests. My AP Physics students were experts at playing the traditional classroom game: many of them can learn as fast as their teachers can talk, so their learning experience consisted of watching teachers explain things and leaving that situation full of knowledge. The teacher decided what to say and when to say it, so these students played a relatively passive role, however effective from a content perspective. Asking these students to find instructional sources, consume them, and then evaluate their usefulness is a lot more work for these students, and involves a lot more uncomfortable uncertainty. Initially, they'd rather just stick with what has worked in the past and not look for what might work better in the future.

[My students] also have discovered more about how their brains work, what they need, and what a good study group feels like.

After only a couple of months, they learn how to operate in the new system and most of them really enjoy the new culture. It honors the individual learner, and their specific experience can vary quite a bit. One student, for example, never needs me. He easily finds the information, learns it, and enjoys the subject matter a great deal. We chat about what resources he uses and his exam scores, but seldom do we discuss content in detail. Another student who excels in physics just as much, loves coming to class and talking to me about what she is learning. Most students do best with technological sources of content, e.g., what they find on YouTube and open online courses and forums, but technology is not necessary for the externally flipped student. Many students find that they can learn from the textbook better than they had assumed in the past. I have one student, for example, who was struggling to learn the content. What he found online was not communicating the concepts to his brain very well, and he had a hard time learning from our textbook. With my help and the help of his parents, he identified and started using his father's old physics textbook from the 1960s. For some reason that dry, visually monotonous tome speaks to him, and he has been excelling in class ever since.

My students know that the information they need is out there in the world, and it is exciting for them to be able to go find it. This prepares them well for the next stage in their education, and their ownership of the material has increased dramatically. It is their duty to learn the content, not my duty to teach it to them. They also have discovered more about how their brains work, what they need, and what a good study group feels like.

About our roles

	Students	Dr Kirwin
Our role	(Ask for/offer) help Find and share resources Learn the material Learn about yourself Participate in evaluation	Create assignments and assessments Manage online class Evaluate students Establish tone and context Coach and cheer lead
Not our role	Fret about grades	Teach physics

Figure 1. A slide from the opening day presentation of my externally flipped AP Physics class.

Busy work is non-existent because they are catering to their own learning needs.

The externally flipped classroom is a gigantic paradigm shift that brings growing pains with it. Students are used to being fed the information, and teachers are used to keeping the gates. In my experience, however, the growing pains are worth what happens to learning once the new normal is accepted. My students know the learning is theirs to do and that I am here to help them when they get frustrated. It addresses huge problems in our education system. It honors multiple intelligences, and the gender and race of students.

One new role of the the teacher in an externally flipped classroom is as a moderator of the paradigm shift. The second year of externally flipping my class went much better than the first. Test scores were higher in the second year, many fewer students dropped the course, and the students seemed generally happier with and more accepting of the approach. I attribute much of these subjective and objective improvements to increased confidence on my part--I could more earnestly sell the external flip because I had some experience under my belt--but also because I got out in front of the sources of cultural tension that our class experienced during the first year. For example, on the first day of class I show the only slide show that I present all year; the presentation aims to explain the external flip. One of the slides contains the information shown in Figure 1. Notice that I point out, on the first day of class, that helping each other, finding sources to learn the material from, and learning the material are the students' job, and that teaching them physics is not my job.

This approach represents a huge change for the students, which is why it is important to address the cultural shift directly. I did this in part by stating the differences between their expectations and how our class would operate on the very first day. Simply describing a cultural shift

is not enough, though. I have to signal to my students that teaching them physics is their job and not mine by *not teaching them physics*. In the days leading up to the first exam, when they were trying to call my bluff by only half-heartedly finding resources and learning the material, I would have undermined the whole culture by backing down and giving them direct instruction on all the material. If I say it is their responsibility to learn the material one day and teach them material the next, a real power shift of ownership and responsibility will never occur. Students will settle comfortably back into the role of passive consumer of instructional input.

Example technology in an externally flipped classroom

Technology in an externally flipped classroom can be categorized as transformational because there is a shift in power within the classroom that was not realistic in its absence. YouTube videos, online classes and online forums are simple tools that have allowed my students to control when and how they learn the required content in my AP Physics class. Technology has made the shift in power possible. The information is out there, and my students go and find it on their own.

Externally flipped classrooms demonstrate one of the central points of our perspective, that the power of technology is not necessarily related to its complicatedness. My externally flipped classroom is based on a three relatively commonplace types of technology: (1) an online calendar that the students can access, (2) a publicly accessible folder for documents that the students can access, and (3) a spreadsheet with analysis functionality. I view those three types of technology as necessary, but I've found a few other types of technology very helpful: (4) a simple website so that students have a place to find the above information, (5) an online homework service that creates and grades unique practice problems for each student, (6) a video sharing service that I can use to store videos of experiment explanations. I initially tried to host (7) an online forum where students could ask questions of each other, but we quickly found that the students would rather manage that aspect of the course among themselves on technology that I don't control; allowing the students to control their own forum was much more effective than controlling it myself because they could use technology that they were already using anyhow.

I have to signal to my students that teaching them physics is their job and not mine by not teaching them physics.

The pieces of technology that I chose are Google calendar, Dropbox, R, Google sites, University of Texas Quest, YouTube, and Facebook, respectively, but many options exist for every one of these types of technology. I am most comfortable with these pieces of technology, but I would not argue that they are necessarily better for flipping a

class than anything else. None of them are specifically designed for flipped classrooms, and all of them (with the possible exception of R[1]) are relatively uncomplicated. Despite their generality, these tools allowed me to flip my classroom very effectively.

Wonder about this the next time you introduce material to you students: how many other people will say pretty much the same thing as you today?

Closing remarks

Like with so many things, the difference between internally and externally flipped classrooms is not entirely binary, rather classrooms lie on a spectrum. If you already flip some of your classes, we hope this discussion has emphasized the importance of thinking critically about how you want technology to influence the power your students have in a flipped classroom. If you are considering flipping a classroom, we hope that you now have a better idea of what to consider as you plan.

The most important idea to keep in mind is that successfully flipping a class is a cultural endeavor. You will have to negotiate the meaning of many different aspects of your classroom with your students, including technology. Approaching these negotiations intentionally will add some order to the process, and will make your experience and your students' experiences with the flipped classroom more positive.

1 R is an open-source statistical programming language. Non-programmers will likely not find the the marginal benefits of using R worth the time it takes to learn to write code; spreadsheets like Microsoft Excel and Google Spreadsheets have sufficient functionality to provide more than enough great information for you and your students to discuss their progress. If you're interested in more information on R, visit its webpage: http://www.r-project.org/