

Introduction

High School Math

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Troy Faulkner teaches today very differently than he did before. “I used to be the one doing all the work,” he recalls.

I lectured and worked on the math problems, while the students sat passively listening, or not listening, as was sometimes the case! Now they can no longer sit back and watch me do the math. They have to be the active ones—it’s their job to solve the math problems. But I’m constantly moving about the class, working with them one-on-one or in small groups: watching and listening; questioning and suggesting; encouraging and nudging; demonstrating and jumping on those just-in-time, just-what’s-needed teachable moments when a student really is ready to learn.

Here’s what his class looks like today: At some point before class begins (the night before, or in the morning before school begins, or during lunch), his students watch a 10- to 15-minute video lesson taught by Faulkner or another Byron math teacher who covers the same course in other sections. As soon as students enter his class, they start on the first of several “peer instruction” problems written on the white board that require them to apply concepts from the video lesson. After answering the question on their own, they discuss

2 Top 10 Reasons Why Flipping the Classroom Can Change Education

their answers and procedures with the students near them. If they disagree on a problem, each must try to convince the others why her or his method and answer is correct. They must come to an agreement on the correct answer or solution and frame their reasons why they support this solution. According to Faulkner,

the students are emotionally involved in their learning, because they must defend their answers. Plus they are really curious: “Is my answer the right one?” It’s a deeper level of understanding as they work through their reasoning and put that reasoning into words.

He listens to the group responses and determines whether there’s been enough disagreement or confusion to warrant reviewing the concept with the class as a whole. After three or four rounds of this cycle of problem solving, sharing, and debating the peer instruction questions, students spend the remainder of the class working through the rest of their math problems around the assigned topic, helping each other as needed. Faulkner walks around the room, helping small groups working together. He’s alert to the students who seem to be struggling but haven’t asked questions, and he often sits with them to help them or pairs them up with others who are comfortable with the particular topic. He calls it “controlled chaos,” but that’s okay with him if everyone is engaged and learning.

Source: T. Faulkner (personal communication, September 20, 2013, and October 3, 2011)

This example illustrates how one teacher has changed his classroom, his teaching, and his students’ mode of learning by flipping the classroom. But haven’t cutting-edge teachers always been trying new things, willing to take risks (at the “bleeding edge” of change) to improve their students’ chances of success? How different is flipping, and what can innovators like Faulkner tell us about where education may be headed?

America’s education system has been compared to a battleship: big and ponderous, slow to change direction. Buzzing

around this mighty enterprise are a flotilla of fads: innovations in content, teaching tools, pedagogical styles, theories, resources, and school designs. They pop up, gain attention, and typically fade from view as yet another educational innovation takes the place of the newest new thing. Teachers complain of reform du jour, and the public is confused, yearning for the good old days of the schools they knew, schools that they believe worked just fine for them!

Flipped classrooms could be the latest hot topic in K–12 education. The concept has recently captured the interest of educators all over the United States and beyond. There is an organization of teachers interested in flipping, and there are online communities, blogs, and NINGs along with websites, videos, books, and articles. Two pioneering educators who popularized the idea—Aaron Sams and Jonathan Bergmann—have become virtual rock stars of flipping.

Beyond the hype, there is solid work being done by creative and deeply committed educators around the country, and there are many good reasons for the interest in flipping. But before we look at the top 10 reasons why flipped classrooms could change education, some background will be useful.

WHAT IS FLIPPING ANYWAY?

Webster's first definition of the verb flip is "to toss" ("Flip," 1939); Macmillan's online dictionary defines it as "to turn over quickly, or to make something turn over" ("Flip," n.d.). These definitions make the flipping-the-classroom metaphor interesting: Are we tossing out the old, or turning over our way of teaching from what was done before?

The term *flip the classroom* refers to inverting the traditional method of teaching; that is, turning upside down the model in which information (the teaching lesson) is presented during class time, and homework is assigned for practice at home. As the above case demonstrates, in flipped teaching (or flipped learning, as some prefer), the teaching lesson is assigned for students to access out of class time,

freeing up class time for building on that lesson with discussion, exercises, labs, or projects. It is just that simple, and just that revolutionary.

HOW DO TEACHERS CREATE FLIPPED LESSONS?

There is no one recipe or template for flipped lessons. Typically, lessons are captured in video format, prepared or curated by teachers. Most flipping teachers produce their own lessons and can be “present” in the video in a variety of ways: They can teach the lesson and be shown full-on teaching, or narrate the lesson while appearing in a small corner of a slide, or provide the voice in the background describing the action on a whiteboard or computer screen. Some flipped lessons aren’t the teacher’s own delivery of content at all; rather, the teacher may assign lessons recorded by other teachers or use videos from educational or entertainment sources online that highlight the teaching concept (e.g., a video of three different versions of a scene in a Shakespearean play). The content—problems from a textbook, demonstrations of an experiment, readings from an original source, illustrations from website or other resource—is as variable as is, well, content.

There is a growing base of software and applications for capturing this content—on audio files, video files, PowerPoint presentations, or screenshot captures of a teacher working on a whiteboard. Whatever the format, the student accesses the information portion of the lesson at home or out of class and then works on it when in the classroom with the teacher and other students.

HOW DIFFERENT IS FLIPPING?

Teachers have always expected students to absorb content as part of their homework. In English classes, teachers assign novels, plays, or poems to be read at home so that class time

can be spent discussing the content. History teachers assign chapters in history texts as a basis for classroom work. Nevertheless, for most teachers in most subjects most of the time, class time is when the majority of content is presented and lessons are delivered.

What is different in flipping is that the actual lesson on which the text, problem, or chapter is based—the teacher-added content—is the work assigned for out of class, offloaded and sent home for students to review on their own time. Students are expected to access and absorb the content *before* class, not through lectures they listen to during the class period. In contrast to the traditional teaching model, in which students come to class to get information, in a flipped model students come to class prepared to discuss, analyze, practice, or apply the information they accessed and absorbed before class.

Without the interruptions of class disruptions, teacher-delivered content can be distilled into short modules, ideally no more than 10–15 minutes each (even shorter for younger children). The student can replay and review each lesson as many times as needed. When students enter the classroom, the teacher assigns activities to practice, deepen, and assess understanding.

Technology gives teachers the opportunity to provide lesson content in a variety of formats and enables students to control both the time when and the speed at which they get the information—and to rewind and review the lessons as often as necessary.

THE FLIPPING MINDSET

Educators like Cheryl Morris suggest that flipping shouldn't be seen as a pedagogy, or instructional technique, or even a theory. Instead, she describes what she calls the “flipping mindset,” which involves three elements:

1. Teachers make the best use of their face-to-face time with students.

6 Top 10 Reasons Why Flipping the Classroom Can Change Education

2. The classroom uses student-centered pedagogy.
3. There is an intentional focus on higher-level thinking, rather than rote memorization. (Morris, Thomasson, Lindgren-Streicher, Kirch, & Baker, 2012)

A more expanded version of this was defined by the Flipped Learning Network in their 2013 study “A Review of Flipped Learning” (Hamdan, McKnight, McKnight, & Arfstrom, 2013). Using the acronym FLIP as an organizing framework, they identified (and even trademarked!) what they call essential elements, unifying themes or requirements for what they call the “Four pillars of F-L-I-P”:

Flexible environments (in terms of timelines, student groupings, assessments, and learning spaces),

Learning culture (a culture built around the learners’ needs, as opposed to a teacher-centered classroom),

Intentional content (teachers designing instruction in a variety of formats to assure contextual understanding and procedural fluency), and

Professional educators (good teachers are critically important though perhaps less visibly present).

A BRIEF HISTORY OF FLIPPING

Technology has always been a magnet for those who want to do things faster, better, and, ideally, cheaper. For educators, this means finding better ways to reach students effectively and help them learn.

Lessons From Higher Education

Research coming out of higher education provided guideposts and inspiration for creative educators at the K–12 level. The work of Harvard physics professor Eric Mazur has been cited by many as a source of inspiration because of his interest in

how technology makes it possible to engage students more actively in their own learning. As early as 1991, Mazur described how he created tutorial text, in the form of electronic note cards that distilled—from thousand-page physics tomes—the essence of key topics studied in an introductory physics course (Mazur, 1991). Mazur was encouraged by the way these resources allowed the students to engage with the content as needed (e.g., clicking on words for definitions or what he called “zoom icons” for a fuller discussion of a topic). He explored how the students could use these outside of class to go deeper into the content of traditional lectures. Mazur’s continuing research and practice around teaching for greater student engagement and learning—with or without technology—and his explorations into ways of blending content delivery out of class with student cooperative learning and discussion within class, led to his leadership in the field of peer instruction, a topic we describe more in Chapter 3.

Other educators in colleges and universities were also looking at how the content delivered to students in large lecture halls could be provided more efficiently and effectively. Few lecturers can keep every student in a lecture hall spell-bound for the entire class period; most are lucky if they keep the majority of them awake until the end of class! But with advances in technology, it became obvious that the basic information delivery system—the lecture—could be videorecorded. Students could watch the lectures on their own devices, on their own time.

In 2000, educators at Miami University published a paper describing what they called “inverted instruction” or “inverted classrooms” for teaching economics (Lage, Platt, & Treglia, 2000). The inverted classroom was one in which “events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa” (p. 32). For them, inverting instruction meant using the technologies of the day—the World Wide Web, multimedia computers, and VCRs—to deliver lectures that students watched in computer labs or at home. Students then did their homework in groups

in class. Although they did not call this flipping, it was an early precursor of today's model in K–12 education

Blended Learning and Online Content for K–12

Online courses were also catching on at the K–12 level, and blended learning became a term for mixing online courses with teacher-directed support in the classroom. Even teachers who were not involved with online courses were discovering the rich treasure trove of free lectures on videos they could download from the Internet. The largest and best known of these free lesson resources is Khan Academy.

Salman Khan began making videos and posting them on YouTube in 2004. His goal was a simple one: He wanted to help his seventh-grade cousin Nadia, who was struggling with algebra. But Khan was in Boston and Nadia was in New Orleans. Unable to tutor her by sitting down next to her, he recorded himself working the problems, discussing what he was doing and why, in short videos he uploaded onto YouTube for her to review. The video tutorials helped Nadia and, to Khan's amazed delight, other learners and teachers began using his video lessons.

Khan began making video lessons covering a range of topics and levels, from basic arithmetic to advanced calculus, from economics and history to astronomy. In 2010 Bill Gates, who had been following Khan's videos and using them to teach his own children, promoted Khan's videos at a conference and others quickly signed on. Gates invested \$15 million in Khan Academy to meet the goal of offering free, high-quality education to anyone with access to the Internet. The Gates grant and support from Google and others made it possible for Khan to hire engineers and designers to pilot new software, including a sophisticated dashboard for tracking student progress.

Today Khan Academy offers thousands of video lessons, along with assessment tools for "coaches," who may be teachers, parents, employers, or friends, located throughout the world. And it's all free (Khan Academy, n.d.).

Bergmann and Sams: Flipping's Early Rock Stars

Teachers in K–12 schools were also beginning to experiment with ways of teaching that used video lessons from a range of sources. While it is likely that some educators were already putting their lessons online for students to watch outside of class, Jonathan Bergmann and Aaron Sams are credited with being the ones to popularize the idea of flipped classrooms in the K–12 sector.

In 2006, Bergmann and Sams were high school chemistry teachers in Woodland Park, Colorado, a mountain community west of Colorado Springs. They were concerned about the amount of class time their students were missing when the students travelled long distances to participate in sports and other activities. Every time a student missed a class, the student was in danger of falling behind. Being conscientious teachers, Sams and Bergman spent what they called “inordinate amounts of time reteaching lessons to students who missed class” (Bergman & Sams, 2012, p. 3). There had to be a better way.

The light bulb went on when Sams learned about a way to put slides, voice, and audio onto a video file that could be placed online. They tried it and, once they began to provide the videos to students who had missed classes, other students began asking for the opportunity to watch their lectures as well. Students asking permission to watch more teaching—how great is that? The videos generated so much interest among their students that Bergmann and Sams decided they would prerecord all their chemistry classes for the 2007–08 school year.

They participated in online forums with other science teachers and made their videos available online. Soon other teachers began to try the videos with their classes. The idea took off. Sams and Bergmann were featured on the local TV station, other districts invited them to share what they were doing, and a movement had begun. What they first called *reverse instruction* became known as *flipped instruction*, now commonly referred to as the *flipped classroom model*, *flipped teaching*, *flipped learning*, or just *flipping*.

HOW COMMON ARE FLIPPED CLASSROOMS?

What began as a teacher-led, bottom-up movement has now become a thriving market as demand increases for examples, training, tools, and services related to flipped teaching. Webinars and videos, books, professional development courses, tools, and products promoting flipping have begun to flood the market. At the same time, teacher-led discussion groups, blogs, and online communities are blossoming as teachers reach out to share their experiences, frustrations, and tips with one another.

The speed at which flipping has spread reflects the power of the Internet as a viral agent for innovation. Educators can see flipping in action with videos posted on YouTube and learn about it through groups like the Flipped Learning Network, whose NING discussion group had 16,000 members as of fall 2013. Their webinars and podcasts regularly attract thousands of participants around the world. Online professional communities like EdWeb's Flipped Learning Community have also grown rapidly.

Nonetheless, this still represents only a small slice of the teaching workforce. A 2013 report from Project Tomorrow, summarizing the results of their 2012 online survey of over 100,000 K–12 educators, provides a window into how many and what types of teachers are flipping their classrooms (Project Tomorrow, 2013b). At the time they conducted their survey, only 9% of their surveyed teachers reported they were flipping, with 6% saying they were using videos they found online and 3% using video lessons or lectures they themselves created. Flipping was most common among science and math teachers, 15% of whom reported they were already flipping their classes. Of the science and math teachers not yet flipping, 23% said they were interested in doing so.

Data from the 2013 survey shed further light on why flipping may take time to take hold. In that survey, 15% of teachers surveyed indicated they were interested in trying flipping, but more (19%) said they had heard about it and were not

interested. It appears that a lack of good information about how to make flipping work remains a barrier, as 42% of teachers were concerned their students would not be able to access the videos at home, 19% said they would need instruction in making videos or finding high-quality videos online, and 16% indicated they would need instruction on how to best utilize classroom time in the flipped teaching model (Project Tomorrow and Flipped Learning Network, 2014).

Interest shown by school leaders may soon impact these numbers, as 40% of school site administrators in the 2013 survey indicated that they were encouraging teachers to implement flipping this year. When asked to rate a number of currently popular approaches to digital learning for their impact on transforming teaching and learning within their districts, 17% of school site administrators, and 25% of district administrators, ranked flipping as having the greatest impact (Project Tomorrow and Flipped Learning Network, 2014). Nevertheless, whole school implementation is still rare. Schools like Michigan's Clintondale High School (www.flippedhighschool.com), declared a "totally flipped high school" in 2012 (see Chapter 4), are still the exception rather than the rule among schools where flipped teaching occurs.

WILL FLIPPING EXACERBATE THE DIGITAL DIVIDE?

One of the most common questions posed about flipped classrooms is "What about students who don't have access to the Internet for watching lessons at home? Won't these students be penalized by their lack of access and fall further behind?" It's an important question, reflected in the teacher concerns reported above. Proponents of flipping suggest that there are a number of reasons why this could pose less of a concern than might be expected. As discussed in Chapter 8, school technology resources are expanding across the board, and many of the tools required for producing and distributing flipped lessons are either already in place in schools, or soon

Table 1 Options for Delivery of Flipped Lessons

If a student has . . .	Then . . .
Computer with Internet capability and service	Lessons can be watched on desktop at home, laptop at home, or outside school.
Computer with no Internet	Lessons can be burned onto a DVD or flash drive and sent home with student.
Tablet or smartphone with Internet access (wireless or 3G/4G)	Lessons can be watched anywhere, anytime when wireless or 3G/4G service is available.
No personal technology, but the school has adequate technology	Laptops or tablets can be loaned to students as needed.
No personal technology, and school technology resources are limited	Students can watch lessons in school computer labs, libraries, or classrooms before or after class.

will be available as part of schools' planning for technology upgrades. Furthermore, recognizing that increasing numbers of students have smartphones and tablets or other mobile devices, many schools are encouraging BYOD (Bring Your Own Device) initiatives to supplement school resources.

Nonetheless, teachers who are considering flipping their classrooms should ensure that all students will have easy access to their lessons before they start. Many teachers survey students and parents about home technology resources and Internet connectivity (see Chapter 7), and then arrange for one or more of the solutions outlined in Table 1.

WHY IS FLIPPING CATCHING FIRE? READ ON!

In this book I suggest 10 reasons that the experts—teachers—suggest are motivations for flipping their classrooms. The

number 10 is an arbitrary figure (reminding us of the zany top 10 lists created by David Letterman on his late night talk show!), but it provides a framework for going deeper into arguments for flipped teaching and learning. These reasons are complementary, blending and reinforcing each other. Importantly, each of these reasons comes with its own set of caveats and warnings to bear in mind. These caveats are presented at the end of each chapter, along with a brief summary of the chapter's key points.

- **Chapter 1: Flipping Maximizes Time for Active Learning.** This is the most compelling reason to flip: maximizing the use of valuable time a teacher has to spend face-to-face working with students in the classroom—time that has been freed up from lecturing.

- **Chapter 2: Flipping Facilitates Differentiated Instruction.** Teachers have more time to watch their students at work, help them individually, and differentiate instruction based on individual student needs and successes.

- **Chapter 3: Flipping Is Grounded in Learning Theory.** When done well, flipped teaching uses pedagogical principles that rest on a solid base of learning theory and cognitive research.

- **Chapter 4: Flipping Effectiveness Data Show Promise.** Although the data are limited, this chapter presents what is known to date about outcomes, describing impacts on student achievement, motivation, and engagement.

- **Chapter 5: Flipping Benefits Teachers Too.** The linchpin to success is the teacher; this chapter discusses how flipping impacts teachers in terms of their roles, learning, and professionalism.

- **Chapter 6: Students Like Flipping.** One of the key inspirations for teachers is how much their students prefer flipped classrooms to traditional classrooms.

- **Chapter 7: Flipping Brings the Classroom to Parents.**

Things are flipped at home when teachers send video instruction home for students to watch out of class; parents need preparation for these changes.

- **Chapter 8: Flipping Makes Effective Use of Resources.**

The technology to support flipping is increasingly available as schools invest in hardware, bandwidth, and digital content, and as students have greater personal access to powerful mobile devices.

- **Chapter 9: Flipping Builds 21st Century Skills.**

Students are using 21st century skills as they use technology to access information in flipped classrooms; teachers use classroom time for activities that build collaboration, creativity, and communication skills.

- **Chapter 10: Flipping the Future.**

This last chapter offers pictures of the future of flipping, drawing on thought leaders outside the flipping movement for their views on how flipping may or may not be a means to “flip reform” for lasting educational improvement.

Let’s explore this top 10 list in detail.