

10 reasons to flip

A southern Minnesota school district flipped its math classrooms and raised achievement and student engagement.

By Kathleen P. Fulton

In fall 2009, the Byron School District near Rochester, Minn., faced a perfect storm of academic and financial challenges. Pushing from one direction was the dire need to order new high school math textbooks because the old ones were dog-eared and poorly matched to new state math standards. Pushing from the other direction was the reality that no funds were available. Two failed operating levy referenda had sunk the district to near the bottom in the state for local funding, and it was coming off a \$1.2 million funding cut during the 2009-10 and 2010-11 school years. The district's annual budget for its 1,743 students — 501 in the high school — is \$18.1 million.



“We literally had no money for new textbooks,” said then-Superintendent Wendy Shannon.

The math teachers stepped up to the challenge and came up with a radical idea: They would create their own curriculum, and, by bringing in online resources, do away with textbooks altogether. Thus was borne the bookless 24/7 math curriculum from which Byron High School’s “flipped classrooms” emerged.

It was a crash course in innovation, given that the teachers hadn’t even heard of flipped classrooms when they began the process. But they were determined to develop their own curriculum aligned to state standards and dedicated to finding the best solution for their students. Beginning in January 2010, they set to work, meeting before school from 6:45 to 7:45 a.m. every Monday during their professional learning community time. As they dissected the new math standards, reviewed student test data indicating areas of special challenge, and pre-viewed resources pulled down from the web, they realized they couldn’t just buy a prepackaged online math curriculum. First, they had no money to do this; just as important, any prepackaged curriculum — traditional or online — presented the same problems of not fully aligning with Minnesota’s state standards. They would have to create an entirely new model.

To fuel their efforts, they landed a \$5,000 grant from a local foundation, the Byron Fund for Excellence in Education, which provided small stipends for teachers to continue to work together during summer 2010 and paid for Kuta, a software tool for creating worksheets and tests. With the help of Jen Hegna, the district’s technology director, the teachers used Moodle to create an online site for each course. Then, they realized they would need to record lecture videos so students and parents would have a resource for when they

were at home in place of the books. And once they began to record lessons on an interactive whiteboard, uploading them onto YouTube, they realized that the students could view these lessons at home as homework, freeing up class time for discussion and practice.

As they worked, adopting some of the concepts of flipped classroom pioneers Aaron Sams and Jonathan Bergmann, they adapted the technique to fit their needs. They started small, experimenting with a few chapters and classes in fall 2010. Today, the innovation has spread to all math courses at Byron High. In addition, 8th-grade mathematics teacher Jeremy Baumbach, who joined the high school teachers in the redesign process, now provides some flipped classes for middle school students. Other departments also are watching and learning from their math colleagues. In fall 2011, Intel awarded Byron High School its School of Distinction Award for Mathematics.

Byron teachers share their top 10 reasons for adopting a flipped classroom.

#1. Students move at their own pace.

In a traditional classroom, the teacher lectures and demonstrates how to solve the math problems during the constraints of the class period. The teacher is doing the active work and the students are passively listening. For some students, the length of the class period is just right, but for those who understand the material, the lectures and questions can drag on and on. Conversely, for those who struggle, there isn’t enough time left after a lecture for them to “get it.” These students must arrange to meet with teachers after class or spend frustratingly long stretches at home trying to recall and make sense of what was delivered in the class lecture.

When classrooms are flipped, students attend each lesson via the homework video. A strong student can breeze through; others can watch it over and over as needed until the concepts become clear. The availability of videos

allows students to review and preview materials as they see fit, giving them control over their academics.

#2. Doing “homework” in class gives teachers better insight into student difficulties and learning styles.

In traditional math classes, teachers see evidence of student struggles when homework papers are turned in — or not — incomplete, or riddled with errors. But exactly what was it that confused the student? With flipping, the teacher is there looking over shoulders as students work on problems in class,

Byron teachers adopted some concepts from flipped classroom pioneers Aaron Sams and Jonathan Bergmann, but adapted the technique to fit their needs.

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where struggles are obvious, and mistakes can be nipped in the bud.

For example, in his precalculus class, teacher Troy Faulkner moves from student to student, cluster to cluster, watching, listening, noting who needs help, and working with students as needed. If several students are stuck on a problem, he might work through more examples on the board at the front of the class. And, just to be sure, there are daily spot quizzes, often using an interactive clicker to grade as they go. The instantaneous feedback allows for group discussion and peer instruction on problems that many students are struggling with and help Faulkner and his colleagues target and revise instruction on concepts that students find difficult. This flexibility and real-time analysis allows for a true and immediate response to student needs.

#3. Teachers can customize and update the curriculum, and provide it to students 24/7.

Even though many teaching videos are available online via open sources like YouTube or Khan Academy, when teachers make their own videos, they can ensure the perfect fit of content, rigor, and personal connections. Students like having the voice behind the lesson belong to someone with whom they have a personal relationship. This

connection strengthens the teacher-student bond that is so important for learning. By designing their own curriculum, Byron teachers also emphasize topics students find most challenging and spend less time on areas where skills are more solid, while still addressing state standards. Based on their collaborative analysis of student work, the teachers update and revise homework videos regularly and bring a variety of other resources into the curriculum.

The 24/7 teaching lessons provide another benefit: a new way of addressing absenteeism. Whatever the reason for students having to miss class — illness, sports, vacations, etc. — their ability to access course materials anytime, anywhere, means they can stay up to date. When they return from an absence, they're not behind and no longer have to come in before or after school for additional instruction on missed content. This frees teacher time as well: Time previously spent creating lesson plans for preplanned absences and/or reteaching absent students can now be spent working directly with students on content.

#4. Students have access to multiple teachers' expertise.

At Byron, teaching assignments often change. For example, three different teachers might teach Algebra II during a given year. If a student has trouble with

a concept presented in the homework video, she is no longer stuck with her teacher's explanation. Rather, she can turn to one of the other teachers' video lessons. Because teachers created a library of all the BHS teacher course videos, students can choose to watch any teacher's videos. Most prefer to watch their own teacher, but some find it helpful to watch a different teacher's video lesson for review or for insight into a new angle for understanding a difficult concept. With the department working from a common curriculum, all teachers' videos cover the same content, even if lessons and examples are presented in different ways.

#5. Teachers flip professional development by watching each other's videos and learning from each other.

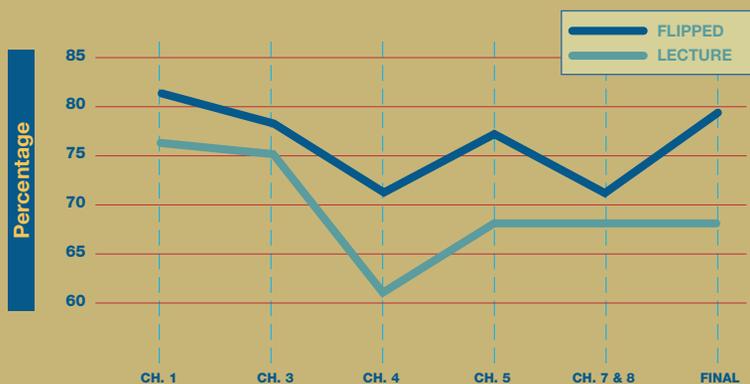
Professional learning communities (PLCs) have been a part of the Byron culture for several years. But the weekly PLCs really came to life when teachers began to devote this time for developing and revising lessons for the flipped curriculum, creating common assessments and class notes, and sharing frustrations and successes. As they analyze student work, noting whose students are successful in which areas, they review each other's videos to see how their colleagues taught the concepts, offering a window into each others' teaching. The open classroom provided by the online resources makes it possible to "visit" each other's teaching, an option rarely available in the real time of a busy school day.

#6. Classroom time can be used more effectively and creatively.

In the flipped classroom, teachers spend more actual time teaching and facilitating instead of just lecturing. Students learn by doing, and, in the flipped classroom, the doing is happening within a hand-raise of the teacher. Students are no longer at home in isolation and unsupported while they do the difficult work of learning. Teachers can use class time to make meaningful contact with students, observing, guiding, and helping.

With the lesson demonstrations now

FIG. 1.
Lecture vs. flipped
(Percentage of students proficient in calculus)



Calculus proficiencies are up on average 9.8%. (Chapter 2 is omitted since it has not yet been taught with the flipped approach.)

moved onto the homework videos, teachers have time in class to try new things — including more hands-on activities and problem-based learning. Math classes have incorporated project-based activities, team challenges, and cross-curricular innovations, which take more time to support now that time previously spent on lectures has been freed up.

#7. Parents have a window into the coursework.

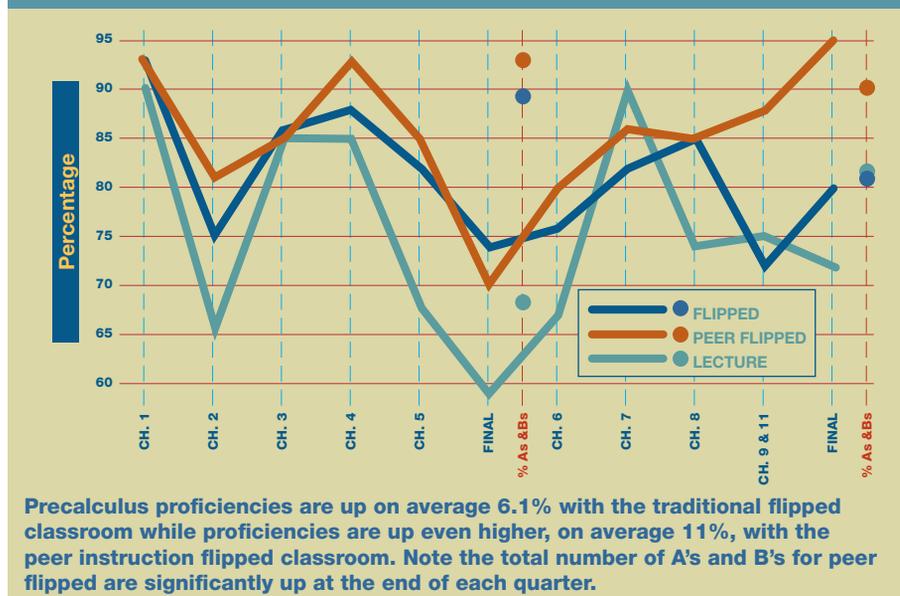
Most parents find it hard to recall the algebra, geometry, or calculus they learned many years ago. Many become frustrated when they're unable to help a child who brings home a math assignment and gets stuck on a problem. They appreciate that the work of explaining math is done in school by teachers. As one parent said, "Since my math skills are a little rusty since I was in high school, I appreciate that any homework questions can be asked in the classroom rather than at home. That approach is much more helpful to students. Less frustration for all of us!"

Furthermore, with the flipped classroom, parents can watch videos with their children, refreshing their own math skills. Byron geometry teacher Jen Green recalls, "I had a young man who was struggling at the beginning of the year. When he began watching the videos at home with his grandfather, they built their understanding of geometry together and shared a growing confidence in being able to do math. The young man came to believe in his ability to succeed and created a special bond with his grandfather in the process." In a voluntary parent survey, 84% said the flipped classroom is their preferred choice in instructional delivery for their children.

#8. Student achievement is increasing, so is interest and engagement in higher-level math.

Byron's math teachers are collecting detailed data on student achievement, and the results are promising. Early data suggest that flipping contributes to significant increases in student learning and achievement as compared to baseline data on the same courses taught in the traditional classroom lecture mode

FIG. 2.
Lecture vs. flipped vs. peer flipped
(Percentage of students proficient in precalculus)



In a voluntary parent survey, 84% said the flipped classroom is their preferred choice in instructional delivery for their children.

using the same assessments.

The accompanying charts show student proficiency (the number of students who are at 80% or above) on unit assessments.

#9. Learning theory supports the new approaches.

The flipped classroom pulls together a number of instructional techniques supported by research on learning theory. Limits on video upload capacity means content is chunked into manageable, understandable units. As they determine how often they need to review a video lesson, students must constantly assess their understanding of material, building thinking skills. With students using classroom time to complete problems demonstrating their understanding, they get immediate feedback on

their work, as well as just-in-time support from teachers and peers. They often view the videos together, work in teams in class, and learn through teaching one another via peer tutoring — approaches validated by social learning theory. For example, some teachers have adopted what educator Eric Mazur calls "peer instruction," asking students to "convince your neighbor" during Q&A time. As Mazur says, "... when one student has the right answer and the other doesn't, the first one is more likely to convince the second — it's hard to talk someone into the wrong answer when they have the right one. More important, a fellow student is more likely to reach them ... You're a student, and you've only recently learned this, so you still know where you got hung up, because it's not that long ago that you were hung up on that very same thing" (Lambert, 2012).

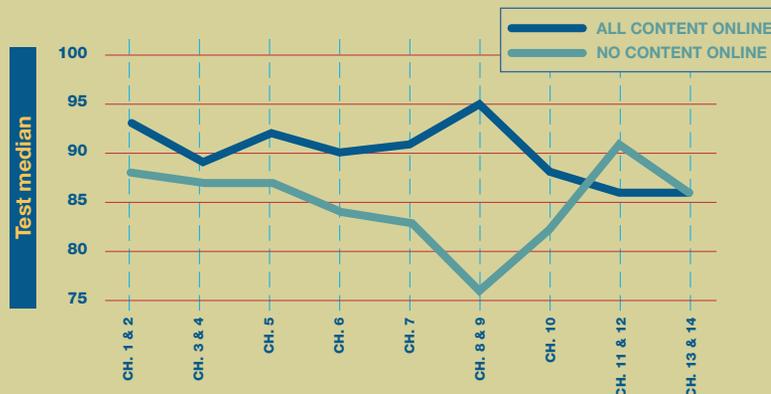
#10. The use of technology is flexible and appropriate for 21st-century learning.

"We need to reach out to the students where they are," said Jen Green. She and her fellow Byron teachers know students have technology all around them and will be using it for learning throughout their academic and professional careers, accessing information

FIG. 3.

Does having digital content online help?

(Median test scores of students in Accelerated Algebra II)



In Accelerated Algebra II, there was a 5.1% increase in test median scores after putting digital content (videos, notes, homework, homework solutions, and extra links to help our students visualize mathematics) online. Geometry students have posted similar gains; overall course failure rates have decreased from 13% with lecture to 6% with flipped classes.

24/7. Believing that learning should happen anytime, anywhere, they have adopted a “bring your own technology” approach. This saves the district money about \$185,000 annually as students are allowed to bring to class and use whatever technology they already own: smartphones, tablet computers, laptops, and iPod Touches. In to-

day’s technology-infused environment, overload can pose a greater problem than access. Sometimes, students can’t log on and watch videos at home if several family members need to use the family computer or get on the Internet in the evening. For these students and those without access to their own technology devices, the school is developing creative solutions: downloaded lesson material on CDs or flash drives, open computer labs, and extra devices available in all classrooms.

Our survey found that 97% of our students have access to high-speed Internet at home. Students who had dial-up access were given the videos on a flash drive. Recently we received our first student request to have the materials delivered via DVD. We complied. Students with no or limited Internet access choose to watch the videos before school or during their lunch in the media center while others go to a friend’s house or use their smartphone.

Last, but certainly not least, is reason # 11: Students like the flipped classroom!

BHS math teachers survey students at the start and end of each course. A sampling of their comments (names

removed) provides a window into why students seem to prefer the flipped classrooms:

— I personally like that I can get through the lessons quicker than when we have . . . class lecture. Then, when I do the homework in class, I can have help right away, which means I ask more questions.

— I liked this approach a lot because, when we work on homework in the classroom, you are here to help us. Otherwise, I would be lost at home and wouldn’t be able to finish my homework because I would have no idea how to do it.

— I liked how I could rewind and pause the lectures in case I didn’t understand something.

— I liked the fact that I could get the more difficult problems in class and be able to ask questions on them.

— I like that we watched the concept at home, but then mastered the concept in class.

— The videos online explain exactly the same way you would if you were to teach the lesson during class. Everyone should be able to understand the lesson, and, if not, they can watch it again.

Throughout the process, Byron has insisted on a solid high-level math education for all students, as shown by the fact that at the end of the 2011-12 school year, 94.5% of Byron’s seniors had completed four or more years of math.

Clearly, educators, students, and parents in the Byron School District didn’t just ride out their perfect storm of fiscal and academic challenges; they are, in fact, making waves that will long affect education in their community and across the nation. For others seeking to improve teaching and learning for a new generation of learners, Byron’s top 10 reasons for flipping a classroom provide a guide for charting a course to success.



Reference

Lambert, C. (2012, March/April). Twilight of the lecture. *Harvard Magazine*, 114 (4), 23-27. <http://harvardmagazine.com/2012/03/twilight-of-the-lecture>

For more information
about the Byron High

School math department,
visit its web site at

<http://tinyurl.com/bhsmath>

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