Pearson

MyLabsPlus educator study tracks subsequent success after taking flipped Finite Math course at University of Arkansas

School name University of Arkansas	**Timeframe** Fall 2013–Spring 2017
Course name Finite Mathematics	**Submitted by** Brian Rickard, Clinical Assistant Professor & Coordinator of Finite Mathematics Deborah Korth, Director of Fulbright Student Success
Course format Hybrid, flipped	
Course materials MyLab Math in MyLabsPlus for *Finite Mathematics* by Lial, Greenwell, and Ritchey	**Results reported by** Traci Simons, Customer Outcomes Analytics Manager

Key Findings

- After flipping the Finite Math course, pass (ABC) rates increased five percentage points. Data set analyzed represents seven years.
- In a voluntary, end-of-semester student survey, 76 percent of respondents said their understanding of course material increased as a result of using MyLab Math.
- 95 percent of respondents said they usually or always completed the pre-class assignments before class.

Setting

Founded in 1871 as a land-grant college and state university, the University of Arkansas (UArk) now enrolls more than 26,000 students representing all 50 states and over 120 countries. The university is the state's foremost partner and resource for education and economic development and serves as the major provider of graduate-level instruction in Arkansas. Below are some "quick facts" about the student population at UArk in 2016:

- Enrollment: 27,194 (Fall 2016)
- Student-faculty ratio: 19:1
- Gender: 52 percent female
- Student residence on campus: 90 percent
- Ethnicity: 75 percent Caucasian, 8 percent Hispanic, 5 percent African American, 2 percent Asian
- Average first-time freshman high school GPA: 3.6, ACT score 26

- Graduation rate: 64.5 percent (six-year rate, 2010 cohort)

About the Course

The Finite Math course at UArk is three credit hours (two hours lecture plus one hour lab/drill) and covers the following topics: selected topics in probability and statistics, review of algebraic matrices, and graphic analysis of linear programming for students in business, agriculture, and social sciences. In addition, the course has a prerequisite of having taken either College Algebra, Plane Trigonometry, Precalculus, or Survey of Calculus with a grade of C or better, or a score of at least 80 percent on the University of Arkansas Mastery of Algebra Exam, or a score of at least 26 on the math component of the ACT exam, or a score of at least 600 on the math component of the SAT.

Challenges and Goals

When Finite Math Coordinator Brian Rickard and Director of Fulbright Student Success Deb Korth took over the Finite Math course, they realized it had slowly become a very algebra-based course. They felt like they were teaching students algebra and were barely able to get into the applications the course was originally designed to feature. By adopting MyLab™ Math in MyLabsPlus™, they hoped to flip the classroom and assign pre-class work so that students would do the calculation exercises on their own time and come to class prepared algebraically to cover more applications. This was important given that the Finite Math course is a prerequisite to Data Analysis.

Implementation

Pearson's Learning Management System (LMS) integration service gives students and instructors easy access to MyLab from their existing school LMS. The University of Arkansas has chosen to integrate its MyLab Math course with Blackboard for the following reasons:

- Single sign-in process: students are ready to work in MyLab on the first day of class;
- Grade transfer: grades are easily transferable from MyLab to Blackboard and there is one single gradebook for the course; and
- Content linking: ability to link to MyLab directly from Blackboard.

Rickard's Finite Math students have just one access code and a single sign-on process instead of the need to log in to Blackboard and additionally sign in to MyLab Math. This results in a simple way for students to start their MyLab assignments, ensuring that they are ready to work from the first day of class. In a voluntary, end-of-semester student survey distributed Spring 2017 (16 percent response rate), 95 percent of respondents indicated they were able to access MyLab Math through Blackboard on the first day of class and appreciated not having a second, separate username and password. In addition, 95 percent of respondents agreed or strongly agreed that the login and registration for MyLab Math through Blackboard was simple and fast.

Course components

Course entry quiz: Students must score 100 percent on a course entry quiz before they can work in MyLabsPlus. The course entry quiz is a syllabus quiz designed to reinforce class policies, procedures, deadlines, etc.

Pre-class assignments: Prior to each class, students have a pre-class assignment in MyLabsPlus composed of videos and problems to prepare them for the class. There are clicker quizzes at the beginning of each class covering these assignments. Pre-class assignments can be worked after the due date for half credit.

Clicker quiz: The clicker quiz is a single, ongoing quiz with questions spread out throughout the semester. One or two questions of the quiz are answered each class period via a clicker, testing students on material from their pre-class assignment(s). The points from each class period are added together at the end of the semester to create one single quiz grade.

Group work: Most days there is in-class group work that is graded by the clicker.

Lab minutes: Students are required to spend an average of 50 minutes per week (600 minutes total for the semester) in one of the teaching labs. Students swipe IDs to mark their time and Rickard runs a report four times per semester. After the first report, students are given an estimate of their grade. Rickard notes that once students see their grade is lower than expected because they haven't been going to the lab, their attendance usually improves.

Homework: Before starting homework, students must complete the Course Entry Quiz and the MyLabsPlus Orientation homework. The Orientation homework is designed to ensure that students are familiar with the system, know how to enter answers, and are aware of the learning aids available to them, etc. Assigning the Orientation homework is a recommended Pearson best practice, and 74 percent of survey respondents agreed or strongly agreed that the MyLab Math Orientation homework helped prepare them for completing work online.

All homework assignments are done on the computer in MyLabsPlus. Students may work on each assignment to improve their grade until it is due. Each homework problem is limited to ten attempts. The Help Me Solve This learning aid is removed for all chapters except those covering sets, counting, and probability; videos are available as learning aids for all sections throughout the course. Rickard notes that they also insert Instructor Tips to link to school-produced videos or give hints.

Online quizzes: There are ten graded online quizzes that students take outside of class time using MyLabsPlus. Students are given three attempts for each outside-of-class quiz and the highest score is counted. There are no makeups for missed online quizzes and at least one online quiz is dropped. Using the prerequisites function in MyLab Math, each quiz requires a certain percentage on the homework before students can access it and must be completed by the date and time listed. The required percentage varies for each quiz, and it is the student's responsibility to check the requirements for each quiz.

Participation points: Clickers are used for attendance, participation, group work, and the clicker quiz. Students earn participation points accordingly.

Prerequisite for each test: Students are required to complete a pre-test homework to at least 90 percent before MyLab will allow them access to the test.

Testing: There are four 100-point tests taken through MyLabsPlus in the department's Testing Center on scheduled dates. Students are allowed 75 minutes for each test. The test is designed to

take 50 minutes but 10 minutes is added to compensate for the extra time needed for typing in answers and another 15 minutes is allowed for possible computer/internet problems. The course policy is that if the internet has a problem during a test that is less than 15 minutes, students will not be given any additional time to complete the test. If the problem lasts for more than 15 minutes, students are instructed what to do. Partial credit is available to students by filling out a claim form requesting to receive credit due a problem being marked incorrect by MyLab because of some student error (rounding, incorrect significant figures, etc.).

Final exam: The final exam is scheduled and is taken on the computer through MyLabsPlus in the Testing Center. Students have two hours (this includes the 15 minutes for internet problems noted previously) to complete the exam. Final exams may also be taken the day before the set final exam date, but cannot be taken earlier than that.

Make-up tests: If students miss a test, they are encouraged to contact their instructor as soon as possible. Most make-up tests are given at the end of the semester in the Testing Lab. There is no partial credit option on make-up tests.

Instructor tools

In addition to MyLab's prerequisites and learning aids regulation functions, Rickard takes advantage of Item Analysis and the Reporting Dashboard in MyLab Math. When writing new tests, Rickard uses the Item Analysis feature in MyLab Math to make sure that pooled questions are similarly difficult. At the end of the term, he uses Item Analysis to find test questions that students may have struggled with in order to make adjustments for the next semester's test.

Rickard uses the Reporting Dashboard to look at quiz and test averages, as well as attendance. He notes, "We often have upwards of 20 sections per semester, so the dashboard gives me an easy place to get a summary of scores from those." The Reporting Dashboard also helps him compare scores across sections as well as from the current semester to previous semesters.

Assessments

- 40% Tests
- 22% MyLabsPlus (quizzes and homework at 8% each, pre-class assignment at 6%)
- 20% Final exam
- 18% Other (clicker quiz 10%; lab minutes 6%; project 2%)

Students have the potential to earn 1,000 total points for the course, broken down as follows:

Assignment	Points available
MLP Pre-class assignment (20 @ 3 pts)	60
MLP Homework (4 @ 20 pts)	80

MLP Quizzes (10 @ 8 pts)	80
Attendance	30
Group work	50
Clicker quiz	40
Lab minutes	50
Finance project	10
MyLabsPlus tests (4 @ 100 pts)	400
MyLabsPlus final exam	200
Total:	**1,000**

Results and Data

Student pass rates in Finite Math were compiled for Fall 2010–Spring 2017 to analyze pre- and post-flipped implementation results (figure 1). After UArk fully implemented the flipped course model using MyLab Math for their pre-class work in Spring 2014, ABC rates rose six percentage points to 71 percent. A *t*-test was run to determine the significance of this difference. Students who took the Finite Math course after it was flipped had a significantly higher pass (ABC) rate (M=71%, SD=3%,N=6) than those who took the course before it was flipped (M=65%, SD=4%, N=5), where $t(9)=2.8$, $p<.05$.

Pass (ABC) rate before and after flipped model

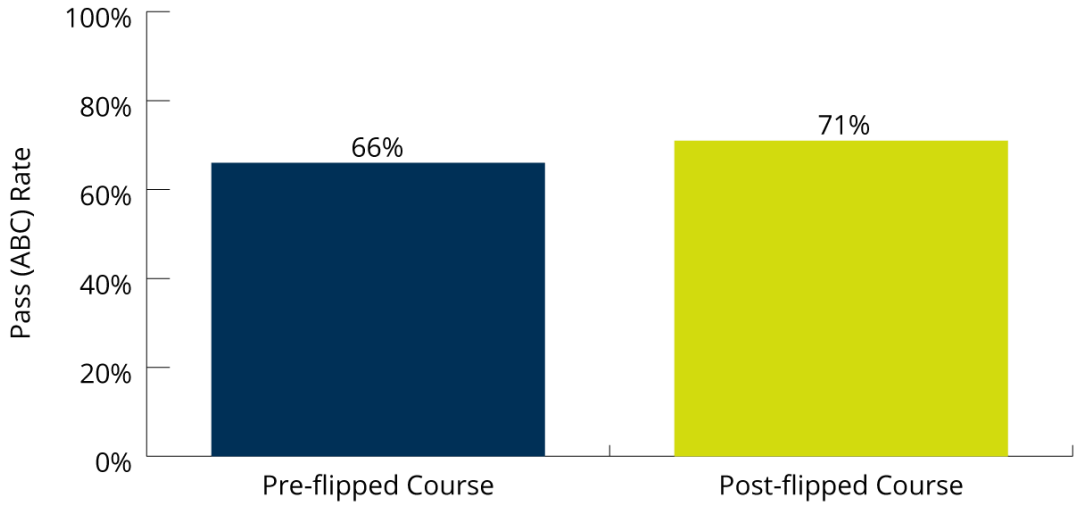

Figure 1. Pass (ABC) Rates Pre- and Post-flipped Course Implementation: Pre-flipped Course, Fall 2010–Spring 2013 (*n*=4,571); Post-flipped Course, Spring 2014–Spring 2017 (*n*=7,669)

UArk's main goal in flipping the classroom was to allow more time to discuss applications in class with the hope that doing so would increase success in the following course, Data Analysis. Students were tracked from their last Finite Math course attempt into their first Data Analysis attempt, and figure 2 shows the success rates of those students.

The Sankey diagram in figure 2 is a specific type of flow diagram, in which the width of the bars is shown proportionally to the percentage of students achieving a specific Finite Math grade. This group is then tracked to their respective Data Analysis grade. This specific Sankey is broken into three groups: students who received an A (blue), B (light blue), or C (orange) in Finite Math. Those groups are then divided into two groups: pre-flipped course and post-flipped course.

One can see differences as follows:

- For students receiving an A in Finite Math, 13 percent of pre-flipped course students earned an A in Data Analysis compared to 15 percent in the post-flipped course.
- Looking at the orange (C) Finite Math students, 11 percent increased their grade to a B in Data Analysis pre-flipped course, while only seven percent did so in the post-flipped course.

Subsequent course success

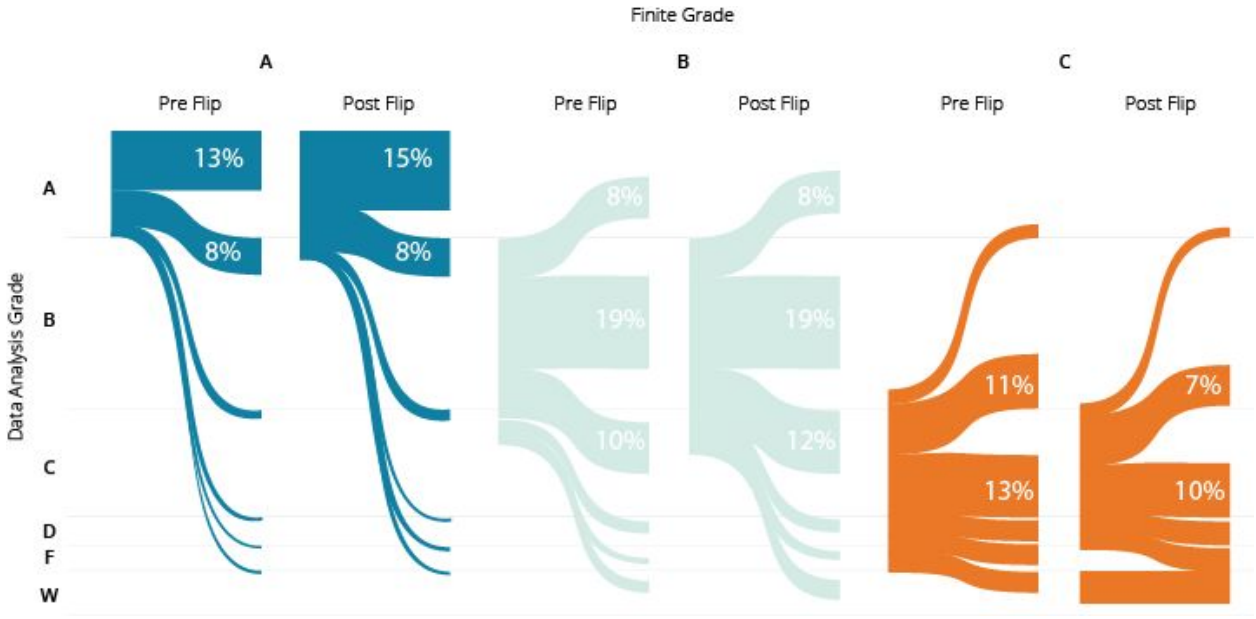

Figure 2. Finite Math Student Success in Data Analysis Pre- and Post-flipped Course Implementation, Fall 2009–Summer 2013, (Pre-flipped Course (*n*=2,974) and Post-flipped Course, Spring 2014–Spring 2017 (*n*=3,289)

Rickard and Korth are pleased with the results of their flipped course. Rickard states, "I think the fact that when we flipped the course and also changed it to focus on application/word problems—which should be harder—the success rates remained fairly steady is pretty good. Of course, I would have liked to have seen Data Analysis grades go up as well, but at least we didn't break anything by making Finite more rigorous! Hopefully we still gave our Finite students some additional skills that will help them in courses other than Data Analysis."

The Student Experience

Responses from a Spring 2017 end-of-semester, voluntary survey of Finite Math students (16 percent response rate) indicate that the flipped classroom accomplished its goal of getting students prepared before class:

- 95 percent of respondents said they usually or always completed the pre-class assignments before class.
- 77 percent of respondents agreed or strongly agreed that knowing there would be a clicker quiz on the pre-class assignment motivated them to complete the work before class.

Overall, 76 percent of respondents said their understanding of course material increased as a result of using MyLab Math, and 70 percent agreed or strongly agreed that MyLab Math positively affected their exam scores.

Selected quotes from the survey include:

- *"The videos are extremely helpful! The practice questions before the exams thoroughly prepared me for the tests!!!"*
- *"It's nice to have everything online and see the whole semester's schedule before it was due. It was nice to be able to work ahead."*
- *"I thought MyLab was helpful because you were able to practice problems over and over until you understood how to do them."*
- *"I love MyLabsPlus because you can go at your own pace and any questions you have will most likely be solved within the site."*
- *"I like that you can get real-time feedback for your answers; it's obviously far preferable to doing your homework completely wrong and turning it in, but beyond that, getting immediate feedback helps you learn more quickly."*

Conclusion

When Rickard first set out to flip the Finite Math course at UArk, he wanted to create a course that was less algebra-focused. Through adopting MyLab Math in MyLabsPlus, Rickard was able to achieve his goal of increasing the rigor of the course while also seeing an increase in pass rates. "Our success rates are higher than they have been since the mid-90s, and we've done nothing but make tests harder, material-wise, by making them entirely application word problems. This is a testament to our course structure and MyLab Math's resources that are able to teach the calculation portion of the problems."

While Rickard and his team are pleased with the way their Finite Math course is working, they are looking into implementing Learning Catalytics in the course to replace their current clicker system. Rickard believes that the current clicker system is not as intuitive as they'd like and costs the students more money. "We just haven't had time to look into it much at this point," he states.