

A CLASSROOM MODEL FOR INCREASING LEARNING AND SUCCESS IN LIBERAL ARTS MATH

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Key Findings

- After implementing a flipped course model, average final course scores improved 11 percentage points in Foundations of Mathematical Reasoning and 14 percentage points in Survey of Mathematics.
- 93% of student survey respondents agreed or strongly agreed that completing pre-class assignments in MyLab Math encouraged them to become familiar with the content.
- The instructor reports improved attendance rates and a drastic decrease in disruptions from mobile phones after implementing in-class MyLab Math assignments.

Study Specifics

School name: Broward College, Davie, FL

Course names: Foundations of Mathematical Reasoning and Survey of Mathematics

Course format: Face to face in computer lab; flipped

Course materials: MyLab Math with *Mathematical Ideas for College and Finite Mathematics* (custom edition) by Miller, Heeren and Hornsby

Timeframe: Fall 2017–Fall 2018

Educator: Dr. Scott Demsky

Results reported by: Traci Simons, Pearson Results Manager

Setting

Part of the Florida College System, Broward College is a state college established in 1959. Its designation as a “state college” means it can offer four-year bachelor degrees. In May 2018, the school was named a top ten finalist for the [2019 Aspen Prize for Community College Excellence](#). The school’s website lists the below [Fast Facts](#) for the 2017–2018 academic year:

- Enrollment: 61,000+
- Average age: 24
- Race/ethnicity: 35% Hispanic, 31% Black, 18% White, 12% Other
- Gender: 58% female, 39% male, 3% unreported
- First-generation college students: 47%

- Enrollment status: 80% part-time students

About the Courses

Dr. Scott Demsky has been teaching the Foundations of Mathematical Reasoning and Survey of Mathematics courses at Broward College for five years. The courses are taught in a computer lab.

Foundations for Mathematical Reasoning

This is a general education course which includes the college-level skills not included in the Pre-Algebra, Elementary Algebra, and Intermediate Algebra courses. The course includes topics in logic, geometry, set theory, probability, and statistics. The course also emphasizes applications to real-world situations and the integration of other disciplines, including (but not limited to) business and the physical sciences. Prerequisites for the course are: recommendation of the Mathematics Department or a grade of C or higher in either Intermediate Algebra or Pathway to Statistics.

Course outcomes include:

1. The student shall be able to demonstrate an understanding of sets, their properties, and some of their many uses.
2. The student shall be able to demonstrate an understanding of logic concepts and apply the precepts of logic to problems.
3. The student shall be able to demonstrate knowledge of plane and solid geometry, and identify and apply geometric principles to solve problems with the aid of a calculator or statistical software.
4. The student shall be able to understand counting techniques and apply methods for computing probabilities.
5. The student shall be able to apply basic statistical principles in various ways with the aid of a calculator or appropriate statistical software.

Survey of Mathematics

This is a general education course which includes college-level skills from a variety of mathematical topics. This course includes the following topics: mathematics of finance; number systems; elementary number theory; and graph theory. This course also emphasizes applications to real-world situations and the integration of other academic disciplines, including (but not limited to) business and the physical and social sciences. Prerequisites for the course are: recommendation of the Mathematics Department or a grade of C or higher in either Intermediate Algebra or Pathway to Statistics.

Course outcomes include:

1. The student shall be able to demonstrate knowledge of various number systems and perform operations within the different systems.
2. The student shall be able to demonstrate an understanding of number theory concepts/techniques and apply them to solve problems.
3. The student shall be able to apply mathematics to solve problems in finance.

4. The student shall be able to recognize different kinds of graphs, circuits, and trees, and relationships among them.

Challenges and Goals

Teaching a course for non-STEM students who are only taking it for their math general education credit puts the instructor in front of students who may not be adept in their math skills. Although this is challenging, Demsky feels the situation makes teaching interesting because he can teach topics that apply to students in real life. However, Demsky found he was struggling to get students to come to class. “I don’t like requiring attendance just to get them into the seats,” states Demsky. For a couple years, he didn’t require attendance, was getting poor attendance and, as expected, students were performing poorly on course assessments. Demsky decided to redesign his course to improve attendance, hoping that it would improve student performance on course assessments.

Implementation

Prior to redesigning his course, Demsky would lecture and then review assigned quizzes prior to tests to prepare students for the high-stakes assessment. In the pre-redesign structure, students had 24 hours after completion of a test to complete a homework assignment that was a copy of the test, but the personalized homework feature in MyLab™ Math allowed students to complete only the questions they missed on the actual test in MyLab Math. In this way, students were essentially allowed to “retake” the test because the grade they received on the post-test homework assignments counted as 30% of their final grade.

“Homework pre-redesign was just about trying to find the students a way of getting a better grade, but post-redesign, homework is all about learning.”

—Dr. Scott Demsky, Associate Professor, Broward College

Demsky decided to start requiring a pre-class assignment (homework) in MyLab Math that requires students to watch a video and view the PowerPoint slides associated with the appropriate section as a prerequisite and then complete 5–6 simple questions before class. This pre-class assignment is designed to introduce students to the material and is due one hour before class. Students can complete the assignment late but with a 50% penalty.

Demsky explains his rationale for pre-class assignments: “One of the worst things a teacher encounters is this notion of ‘tabula rasa,’ meaning ‘blank slate.’ You don’t want students coming in as blank slates to class. You want them to understand at least something about what you’re going to be teaching them so that they can learn more during class. So, these pre-class assignments are designed to decrease the ‘tabula rasa.’”

Together as a class, students complete another homework assignment in MyLab Math comprised of 7–8 questions that are a little more difficult than the pre-class assignment. Instead of lecturing, Demsky teaches in the context of doing the problem. Demsky reports

that students seem to pay attention more in class than they did when he lectured because they can complete their assignment. Using MyLab Math's assignment settings, Demsky has the in-class assignment open at the beginning of class and close at the end of class. It is also password-protected so that it's only available to students who come to class. Once the assignment closes, students can view it, but can no longer improve their score. This serves as their attendance grade. As a result, Demsky reports that attendance is better and discussions in class are livelier. Another positive side effect of the active learning in class is Demsky now has zero problems with the distraction of mobile phones because the students are so busy focusing on the problems and work at hand.

To address absences that are excused, Demsky drops the five lowest homework scores at the end of the semester. Demsky also assigns two section quizzes per chapter, with about 20 questions each, and students can attempt the quizzes multiple times. Questions range in difficulty from simple to complex. Quizzes are due on test day and students can complete them after the due date for half credit. Quizzes are reviewed during the class before the test.

Tests are given in class in MyLab Math and makeups are only allowed with an excused absence (per Broward College policy). The Survey of Mathematics class also requires completion of a course project where students pretend to buy a house and must complete the necessary paperwork.

Assessments

Foundations of Mathematical Reasoning

- 30% Homework
- 30% Quizzes
- 40% Tests

Survey of Mathematics

- 10% Project
- 30% Homework
- 30% Quizzes
- 30% Tests

Results and Data

Average course performance from two semesters before the redesign (Fall 2017 and Spring 2018) was compared to the first semester after redesign (Fall 2018). Before the redesign, Demsky had similar quizzes and tests as far as difficulty and subject matter. Demsky explains that homework was where the biggest difference was. Pre-redesign, homework consisted only of one personalized homework assignment per chapter based on the chapter test performance, with the goal of helping students improve their grade on the assessment; whereas, post-redesign, homework is preparatory in nature with the goal of helping students to perform better on their one and only attempt at the chapter test.

“Homework may have even been easier pre-redesign,” Demsky posits. “There was a post-test personalized homework, but they only had to do the homework problems that they didn’t perform to standard on the test. Post-redesign, there are 8–10 times more homework problems than there were pre-redesign, and homework scores are still coming out better.” Thus, students are doing more homework and are still performing better in all three categories. Demsky states, “Homework pre-redesign was just about trying to find the students a way of getting a better grade, but post-redesign, homework is all about learning.”

Foundations of Mathematical Reasoning

In Foundations of Mathematical Reasoning, students performed better on all assessments after the redesign (Figure 1). In fact, comparing the average of Demsky’s Fall 2017 and Spring 2018 sections of Foundations to the average of his Fall 2018 sections, student performance rose as follows:

- 10 percentage point increase on homework
- 18 percentage point increase on quizzes
- 8 percentage point increase on tests
- 11 percentage point increase on final course score

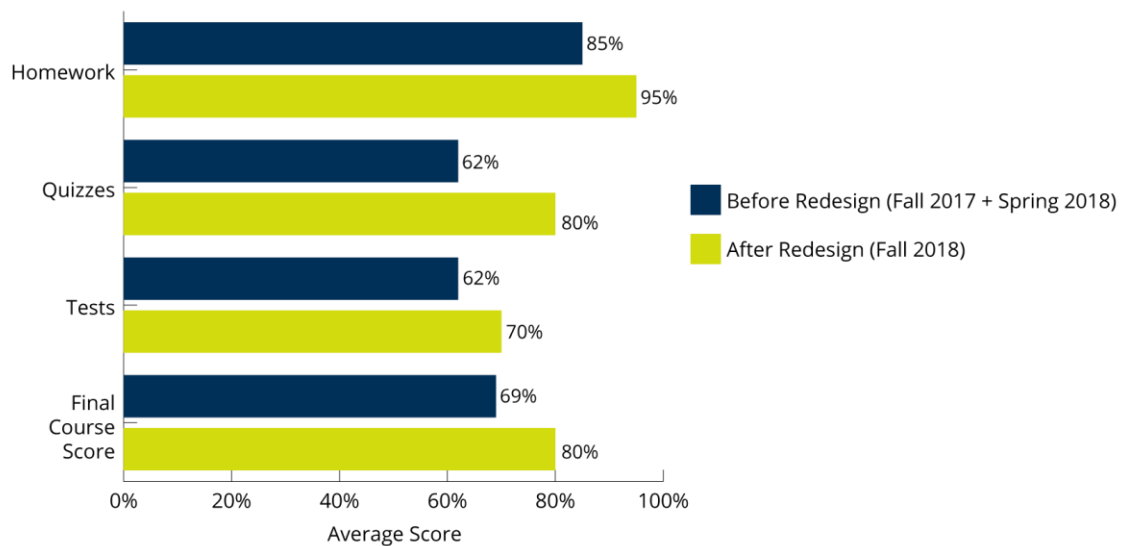


Figure 1. Foundations of Mathematical Reasoning Student Performance Before Redesign: Fall 2017 ($n=24$) and Spring 2018 ($n=21$); After Redesign: Fall 2018 ($n=56$)

In addition, Demsky was delighted to see the improvement in As, Bs, and Cs when he compared the distribution of his sections pre- and post-redesign (Figure 2). Demsky’s redesigned Foundations sections had an 88% ABC rate compared to his pre-redesigned sections, which had a 71% ABC rate. Demsky states, “Obviously this is only one semester’s worth of data, but I would hope it shows that the structure of the class is helping students learn more and perform better as a result of increased learning.”

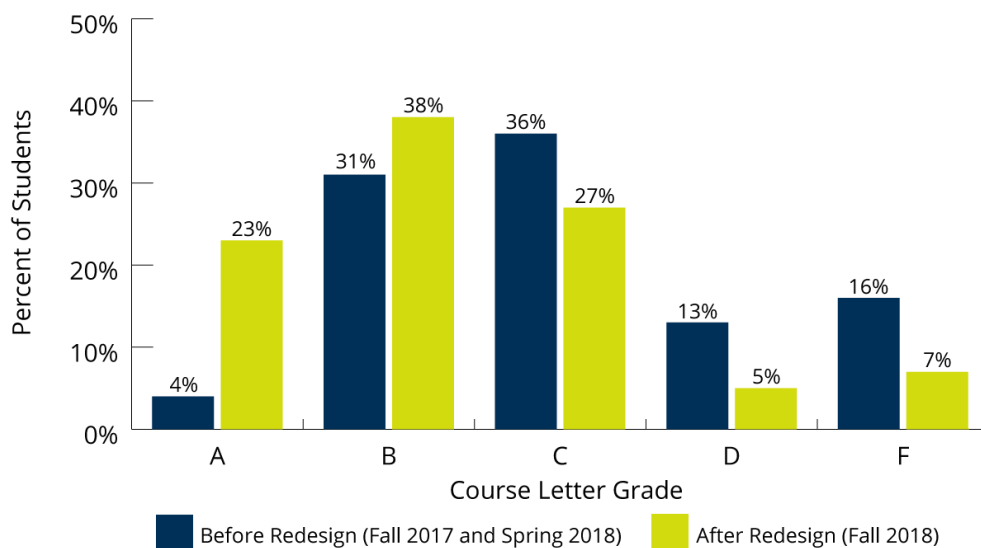


Figure 2. Foundations of Mathematical Reasoning Course Letter Grade Distribution Before Redesign: Fall 2017 ($n=24$) and Spring 2018 ($n=21$); After Redesign: Fall 2018 ($n=56$)

Survey of Mathematics

Demsky's Survey of Mathematics course has seen even more substantial improvement post-redesign (Figure 3). Again, comparing Demsky's Fall 2017 and Spring 2018 sections to his Fall 2018 section, average assessment scores increased as follows:

- 11 percentage point increase on homework
- 16 percentage point increase on quizzes
- 13 percentage point increase on tests
- 12 percentage point increase on course project

As described above, the course project is completed during the Personal Finance portion of the course and students are required to complete the necessary paperwork to purchase a home. Demsky posits that the substantial increase in course project scores could be in part due to the new structure of the course. "With the old lecture style, it would be possible that a lecture would go unfinished one class and would have to be finished the next class," Demsky states. "This would then infringe upon the next scheduled lesson and could potentially snowball." He says that this situation tended to happen a lot during the finance section of the course because it's more difficult material for students. Demsky reports that he has never run over any lecture since implementing the new structure "because each class is allocated to that one in-class assignment" and, in fact, he reports that there is often time left over to have a deeper conversation or to review quizzes, which he says is helpful for two reasons: 1) it increases learning, and 2) it reminds students to do the quizzes. Thus, because classes never run over, Demsky can spend more time explaining the project. He summarizes, "In general, it's nice to always be on time and always finish a topic. It's a very clean model."

Finally, the average final course score in Demsky’s Survey of Mathematics course rose 14 percentage points post-redesign, from an average of 70% pre-redesign to 84% post-redesign. Upon reflection, Demsky was more than pleased to notice this change and points again to the structure of the class leading itself to better performance.

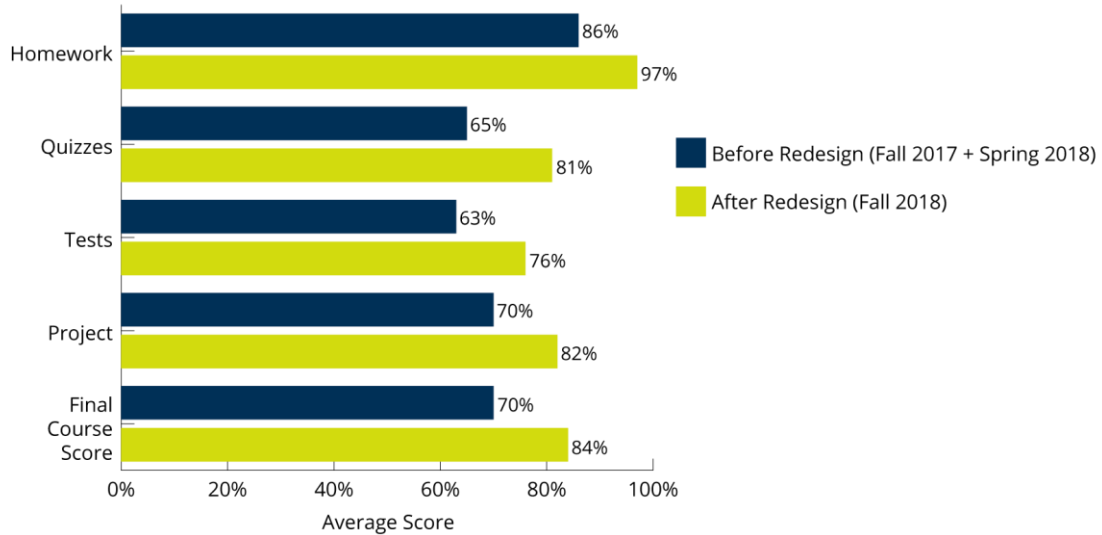


Figure 3. Survey of Mathematics Student Performance Before Redesign: Fall 2017 ($n=22$) and Spring 2018 ($n=28$); After Redesign: Fall 2018 ($n=14$)

In addition, the course grade distributions improved post-redesign (Figure 4). In Demsky’s Fall 2018 Survey of Mathematics section, 93% of students (all but one) received an A, B, or C, compared to the previous two semesters (pre-redesign) which had an average ABC rate of 62%.

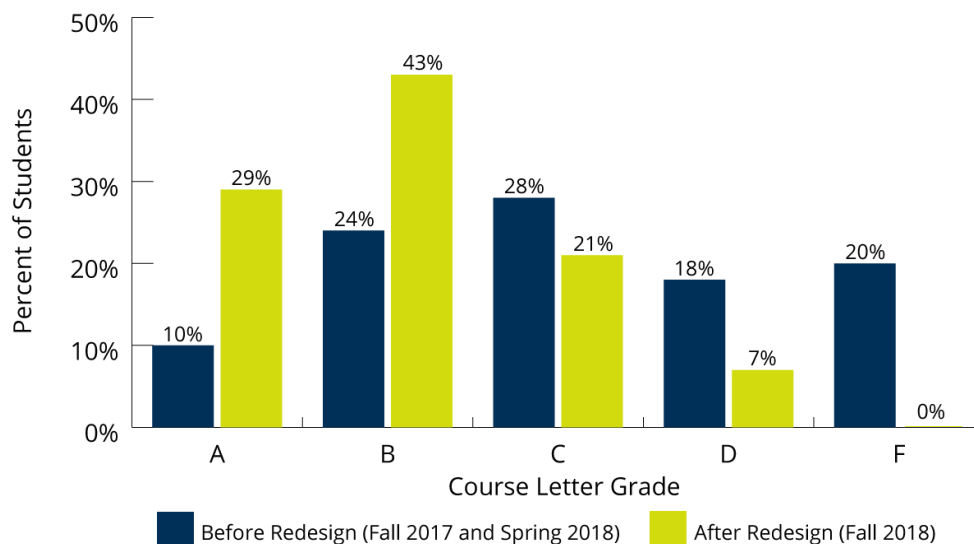


Figure 4. Survey of Mathematics Course Letter Grade Distribution Before Redesign: Fall 2017 ($n=22$) and Spring 2018 ($n=28$); After Redesign: Fall 2018 ($n=14$)

The Student Experience

Demsky deployed a survey to his Fall 2018 students after the semester was over. While the response rate (21%) was lower due to the timing of deployment, it's likely that student answers are unbiased as their grade for the course had already been published and they had nothing to gain or lose based on their responses.

Students were asked to rate statements with strongly disagree, disagree, agree, or strongly agree. Results from respondents are shown in Figure 5.

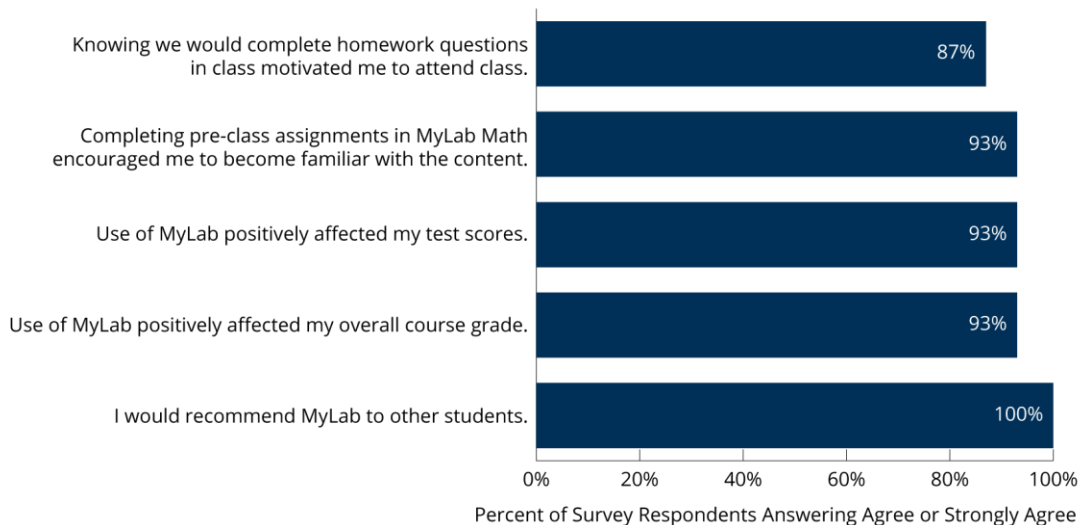


Figure 5. Percent of Student Survey Respondents Answering Agree or Strongly Agree, Fall 2018 ($n=15$)

Conclusion

Demsky is very pleased with the way the changes to his course structure have transformed his students' participation and performance. In the first semester of implementation, he achieved his goal of increasing attendance and performance in the course. His next goal is to work out a way to use the model in a classroom that isn't a computer lab so that he can incorporate the structure in his Precalculus course. Demsky states, "I think the model is a good one and has shown to work for non-STEM courses. I think it would work well for my Precalculus students. If I get the chance to do it, I would assign pre-class homework assignments and section quizzes in MyLab Math and probably do a paper worksheet in class, not only due to the limitations of the Precalculus class not being in a computer classroom, but more so because Precalculus problems contain more work, and I would want to see their work to see their train of thought. I might also assign a post-class homework assignment in MyLab Math. Tests would still be on paper during class." Demsky plans to develop his flipped Precalculus course during the Spring 2020 Semester.