MONTANA STATE UNIVERSITY BILLINGS

Billings, MT

Product Name MyMathLab

Course Name Introductory and Intermediate Algebra

Course Format Face-to-face

Key Results When controlled for pre-COMPASS scores, students who participate in a modularized, combined Introductory and Intermediate Algebra course perform significantly better in subsequent courses of College Algebra (eight percent higher) and Finite Math (seven percent higher) than students who take the traditional two-semester Introductory Algebra and Intermediate Algebra sequence.

Submitted by
Developmental Mathematics Team

Course materials
MyMathLab and *Elementary and Intermediate Algebra,* Carson and Jordan

Setting

Montana State University Billings, one of six universities in the Montana State University System, is located in downtown Billings. The majority of the school's nearly 5,000 students attend full time; 82 percent are Caucasian and 86 percent are from Montana. The school has an open access policy[1] and a student-to-faculty ratio of 19:1.

The combined Introductory and Intermediate Algebra course covers basic algebra concepts, including terminology, operations on rational numbers, linear equations and inequalities in one and two variables, equations of lines, polynomial and function operations, operations on exponential and radical expressions, factoring, rational/absolute value/radical and systems of equations, and quadratic equations. Students who score between 16 and 50 on their COMPASS tests are eligible for the course, which is modularized and based on a mastery learning system whereby students earn credit for each of four learning modules by examination (A, B, C, D), plus a fifth course final module (E). Students meet in a classroom for lecture five times per week, and each module is taught in a separate classroom. MyMathLab is assigned as outside homework.

Challenges and Goals

In about 2008, mathematics faculty noticed an increase in the number of developmental math students entering Intermediate Algebra with noticeable knowledge gaps–many students were forced to repeat the entire course despite having passed a part of it. They explored a variety of modularized programs and, ultimately, created their own: a combined Introductory and Intermediate Algebra course.

The new course was piloted in 2009 and 2010, and was formally implemented in 2011 with the hypothesis that students would complete the two courses more quickly—and with fewer gaps in knowledge—in a mastery-based, modularized format.

Implementation

At the beginning of each semester, students take a series of MyMathLab pretests that mimics the learning outcomes of that module. They have five days to prove mastery by earning an 80 percent or higher on each module pretest. If they score below 80 percent, they are required to complete personalized homework and other remediation offerings before attempting the pretest a second time. Students who score 80 percent or higher on the pretest earn credit for that module and are allowed to start the next module's pretest. At the end of the five days, students are placed into the appropriate module as indicated by their demonstrated knowledge.

Because so many students place into Module A, faculty create groups within that class based on pretest performance; lecture and classroom activities are adjusted based on the needs of each group. Students spend 15 days in each module before either repeating it from the beginning or moving to the next one.

[1] http://www.msubillings.edu/catalogs/ug_2013-2015/pg020.html

Faculty use the program's announcements feature and rely heavily on the Search/Email by Criteria function in the gradebook, which enable them to make contact with every student and offer feedback based on weekly performance.

The following MyMathLab prerequisite activities are designed to ensure mastery of each module:

- **Homework.** Students must score 100 percent on MyMathLab homework (generally 1 assignment per section, 12 assignments per module, 10 questions per assignment, and 3 attempts per question). Students may miss one question and still move to the next assignment so that they continue to progress, but must successfully complete any skipped problems before taking the module exam. Students who unsuccessfully use all their attempts must meet with an instructor for tutoring.
- **Quizzes.** Students must score 80 percent or higher on MyMathLab quizzes (3–4 per module, no learning aids). Quizzes are untimed, and questions are pulled from the homework assignments. Students who earn less than 80 percent are required to complete personalized homework generated by MyMathLab based on their quiz performance. Students who score less than 80 percent on their second attempt must show their work to an instructor who either gives them partial credit or approves a third attempt.
- **Tests.** Students must score 80 percent or higher on paper-and-pencil, in-class tests in order to pass each module. If a student earns 77–80 percent, the instructor individually regrades the test and decides if the mistakes were major or minor; students who earn 70–77 percent receive a review from a different instructor.

In addition to MyMathLab's prerequisites feature and personalized homework capabilities, faculty use the program's announcements feature and rely heavily on the Search/Email by Criteria function in the gradebook, which enable them to make contact with every student and offer feedback based on weekly performance.

Assessments

The final grade for each module is weighted as follows:

90 percent	Module test *(paper-and-pencil, in class)*
10 percent	Process assignments from book or in class

Students must demonstrate mastery in MyMathLab in order to take the module tests. Mastery is demonstrated by completing all MyMathLab homework and earning a score of at least 80 percent on all module quizzes; it is not weighted toward the final course grade.

Results and Data

Data were analyzed for both the stand-alone Introductory Algebra and Intermediate Algebra courses (traditional) and the combined Introductory and Intermediate Algebra course (module). Although Table 1 shows a lower pass rate for the redesigned, modular course, the course completion rate improved by an average of five weeks.

For comparison purposes, data from the modularized course were examined according to who *would have* placed into either of the traditional courses (Table 2).

- Similar pass rate trends emerged for both formats.
- 46.29 percent of the module students who would have placed into the traditional Introductory Algebra course

Format	Performance Metric	Failed	Passed
Module	Average GPA	1.1	2.6
	Average number of weeks to completion	10.3	13.3
	Average pre-COMPASS score	22.6	27.2
	Percentage of students	46.50%	53.50%
	Number of records	472	543
Traditional	Average GPA	1	2.5
	Average number of weeks to complete	18.5	19
	Average pre-COMPASS score	23.8	29.7
	Percentage of students	39.07%	60.93%
	Number of records	463	722

Table 1. Modular and Traditional Format Performance Metrics, Fall 2011–Spring 2014 (n = 2,200)

Format	Performance Metric	Failed		Passed	
		Module	Traditional	Module	Traditional
Introductory Algebra	Average GPA	1.1	1.2	2.6	2.5
	Average number of weeks in course	9.8	18.9	13.9	31.4
	Average pre-COMPASS algebra score	20.2	20.6	21.5	22.4
	Percentage of students	53.71%	66.90%	46.29%	33.10%
	Number of students	384	289	331	143
Intermediate Algebra	Average GPA	1.1	0.7	2.5	2.4
	Average number of weeks in course	12.6	17.8	12.5	15.9
	Average pre-COMPASS algebra score	32	29.9	34.7	31.8
	Percentage of students	29.33%	23.11%	70.67%	76.89%
	Number of students	88	174	212	579

Table 2. Modular and Traditional Format Performance Metrics by Introductory Algebra and Introductory Placement , Fall 2011–Spring 2014 (n = 2,200)

passed the course, compared with a 33.10 percent pass rate for traditional Introductory Algebra students.

- Students in the module course who would have placed into the Introductory Algebra course took an average of 13.9 weeks to complete the sequence. In contrast, students who took the traditional course sequence took an average of 31.4 weeks—more than twice as long as the module students.

Even more encouraging are the module course's subsequent success rates. Figure 1 shows an analysis of final course scores from seven courses students can take upon completion of either Intermediate Algebra (traditional) or Introductory and Intermediate Algebra (module). When controlled for pre-COMPASS scores, the difference between the subsequent performance of module and traditional students was found to be statistically significant in two of three courses most likely to be taken after developmental studies. In both cases, students from the modular course performed better. Module students scored 8 percent higher in College Algebra (p value < .01) and 7 percent higher in Finite Mathematics (p value = .05) than their counterparts who took the traditional, two-course sequence.

Students in the modular section also scored 7 percent higher in Introduction to Statistical Concepts, the third most common course to follow the developmental math sequence. These results were not statistically significant (p value = .81).

Figure 1 shows a box-and-whisker plot of module and traditional student performance in college-credit courses.

Scores were rescaled according to students' pre-COMPASS scores. For each course, a dot is an individual data point, or score, for a particular student. The whiskers extend 1.5 times the interquartile range, thus illustrating the entire distribution. The boundary between the two shaded areas is the median for the distribution of scores, and the entire shaded area (box) is 50 percent of the student body—the lighter green represents percentiles 50–75, the darker green represents percentiles 25–50.

The Student Experience

An end-of-semester survey was distributed to all students in spring 2015 (n = 136). Of the 66 students who participated in the survey, 13 were enrolled in the traditional Introductory Algebra course, 30 were enrolled in the traditional Intermediate Algebra course, and 23 were enrolled in the modular combination Introductory and Intermediate Algebra course.

Students self-selected enrollment in the modular, combined course or the traditional, two-semester Introductory Algebra and Intermediate Algebra sequence. They were given information describing the module course, and it is believed that word of mouth also helped students make their decisions. When asked why they chose the course they did, more than half of the students (34 of 62) were either unaware of the other option or were advised to take that particular course.

Responders from the modular, combined course were asked to assess the components of the course (Table 3).

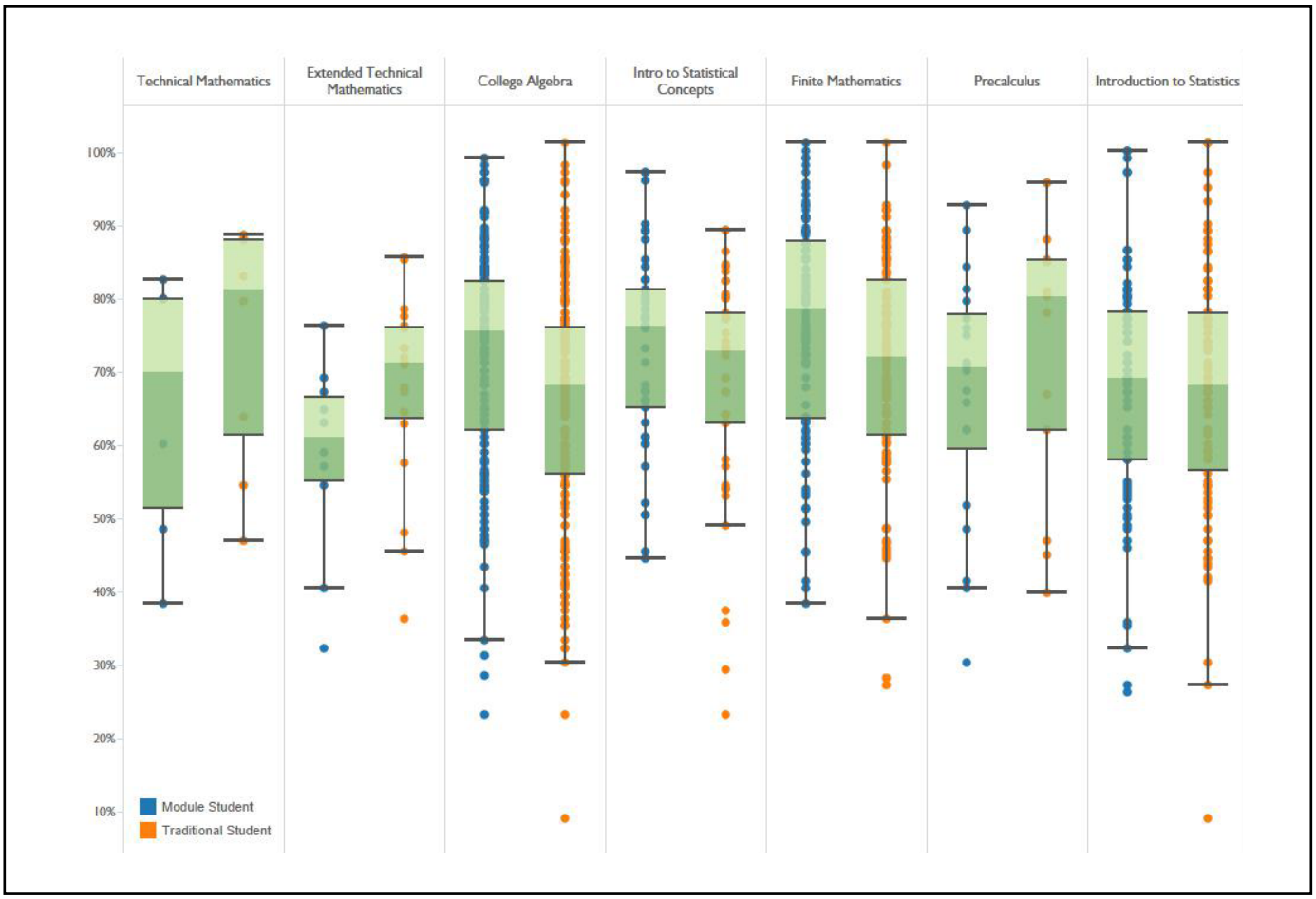

Figure 1. Module and Traditional Student Performance in College-Credit Courses, Fall 2011–Spring 2014 (Technical Mathematics, *n* = 19; Extended Technical Mathematics, *n* = 31; College Algebra, *n* = 383; Intro to Statistical Concepts, *n* = 103; Finite Mathematics, *n* = 210; Precalculus, *n* = 41; Introduction to Statistics, *n* = 192). Note: The grade on the *y*-axis is the pre-COMPASS controlled grade, and this accounts for the variation. The formula for this grade translation is based on the average pre-COMPASS Algebra score (27), the standard deviation (9), and the standard deviation of the letter grades (10 percent), and then is rescaled to be between 0 and 1 (hence dividing by 1.1).

Course Component	Very Beneficial	Somewhat Beneficial	Somewhat Unhelpful	Very Unhelpful
Taking placement tests during the Review and Assessment Block to determine which module you were placed into	11	8	1	3
The opportunity to test out of modules during the Review and Assessment Block	11	8	0	4
The requirement of repeating modules you had not yet mastered*	8	6	4	4
The mastery requirements of MyMathLab homework and quizzes	11	6	2	4
The "practice for quiz" before your second attempt	10	9	1	3

Table 3. Student Survey Responses, Spring 2015 (*n* = 66**)

**One student left this question blank.*

***Sixty-six out of 136 students took the survey; 23 of those students were enrolled in the modular course, and all 23 answered the survey questions.*

(continued next page)

Although some students responded that they felt the 80 percent or 100 percent thresholds were too high, their comments indicated that they understood and appreciated the rationale behind it.

Comments suggest that they understood the value of and appreciated the placement tests.

- *"The amount of information in the [combined, modular] course is extreme, but the placement test placed me exactly in the correct spot and so far I have succeeded."*
- *"I loved that we tested out so we knew if we understood it enough to move ahead."*

Students also seemed to understand the requirement to repeat modules that weren't mastered.

- *"It really made me want to work hard to make sure I didn't have to repeat any of the modules."*
- *"If I failed to learn something, I had to redo it before moving on."*
- "*It's very important to move on only when you have mastered the material."*

Similarly, although some students responded that they felt the 80 percent or 100 percent thresholds were too high, their comments indicated that they understood and appreciated the rationale behind it.

- *"Even though it's a lot of work and sometimes hard to make time for it all, in the end it's very helpful. Doing the problems over and over helped me better understand them."*
- *"Scoring 100 percent is difficult, but I study more carefully and the Help Me Solve This button is awesome."*
- *"Although [the threshold] was hard, it helped me when it came to the test."*

The students who responded to the survey repeated this awareness when asked about the amount of time required by the personalized practice quizzes before allowing second attempts: they understood the purpose behind it and, ultimately, saw that it helped them.

- *"This is a pain in the butt, but I have to admit, it better prepared me to take the quiz."*
- *"Seemed very tedious at the time, worth it in the end."*
- *"I liked that it forced me to work on problems that I didn't fully understand."*

The modular, combined course relies heavily on email communication to promote that students feel connected to and supported by their instructors. According to the student survey, 100 percent of responders received email communications from their instructor (via MyMathLab's Search/Email by Criteria feature). Twenty-two of the 23 responders reported that the email was "mostly positive;" 18 of the 23 reported that it "motivated them to make a change in behavior or performance." According to one student, "If I fell behind, [my instructor] let me know. In turn I was better motivated to work on assignments."

Conclusion

When asked about the school's progress in achieving its goals for the combined course, Chairsty Stewart, developmental education department chair, points to the student survey comment: "MyMathLab is difficult, but it's preparing me for harder math."

"That's our goal," she says. "We're trying to prepare students for success in their next courses–and we're getting there."

Future plans include requiring students to come to class to learn the results of their first tests versus checking online. The department noticed that students who don't pass their first test are hard to retain. Faculty hypothesize that if students are required to attend class, instructors will have the opportunity to encourage them to persevere and coach them on how to improve.

Implementation and results case studies share actual implementation practices and evaluate possible relationships between program implementation and student performance. The findings are not meant to imply causality or generalizability within or beyond these instances. Rather, they can begin to provide informed considerations for implementation and adaptation decisions in other user contexts. For this case study, mixed-methods designs were applied, and the data collected included qualitative data from interviews, quantitative program usage analytics, and performance data. Open-ended interviews were used to guide data collection.