

## MyLab Math educator study explores benefits of Gaze’s quantitative reasoning curriculum at Lake Michigan College

<p><b>School Name</b> Lake Michigan College, Benton Harbor, MI</p> <p><b>Course name</b> Quantitative Reasoning</p> <p><b>Course format</b> Face to face</p> <p><b>Course materials</b> MyLab Math with <i>Thinking Quantitatively: Communicating with Numbers</i> by Eric Gaze Guided Worksheets by Eric Gaze</p>	<p><b>Timeframe</b> Fall 2013–2016</p> <p><b>Submitted by</b> Peter Brown, Instructor Chris Bendixen, Instructor</p> <p><b>Results reported by</b> Traci Simons, Pearson Customer Outcomes Analytics Manager</p>
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### Key Findings

- Using the Gaze MyLab Math course materials as a capstone course for non-STEM majors allowed the instructor to build remediation needed to support his vision for the course.
- Students in the MyLab Math-supported Quantitative Reasoning course showed learning gains of 3.6 points (63 percent) from pre-test to post-test (final exam) scores on an NSF-supported, non-proprietary assessment instrument.
- Final exam scores were 1.8 points (24 percent) higher than the national mean on the same assessments.

### Setting

Lake Michigan College (LMC) is a regional, two-year community college offering bachelor’s and associate’s degrees, certificates, and a wide range of continuing education and workforce training. According to the school’s website, the Fall 2014 student population consisted of the following:

- Number: 4,200 total students
- Status: 29 percent full-time

- Gender: 60 percent of students were female
- Residency: 79 percent of the students claimed in-district residency
- Age: 35 percent comprised either the 18-or-under or the 19–24 categories.
- Ethnicity: 59 percent Caucasian, 13 percent African American, and seven percent Hispanic/Latino (17 percent did not report an ethnicity).

When looking at the first-time, full-time, degree-seeking students, the Fall 2010 cohort started with 522 students. By the end of the 2012–2013 academic year,

- 92 students (18 percent) of those students had completed their certificate within 150 percent of the expected time (three semesters for a one-year certificate or six semesters for a two-year certificate);
- 150 students (29 percent) had transferred out;
- 48 students (9 percent) were still enrolled;
- 232 students (44 percent) were no longer enrolled; and
- 40 students (8 percent) graduated within 100 percent of expected time (two semesters for one-year certificate, four semesters for two-year certificate).

In terms of retention, the Fall 2012 cohort had 459 total full-time, first-time degree-seeking students and 51.2 percent of them were retained the next fall. The Fall 2012 cohort also had 347 part-time, first-time, degree-seeking students, and 36.3 percent of them were retained the next Fall.

## About the Course

The Quantitative Reasoning (QR) course at LMC is a four credit-hour course designed to provide students with relevant mathematics and critical thinking skills they will need for their future college courses, their careers, and their civic lives. The design provides a thematic, contextual approach that covers the fundamental quantitative skill set in depth. Topics include ratios, rates, percentages, units, descriptive and inferential statistics, linear and exponential modeling, correlation, logic, and probability. This project-based course uses Microsoft Excel and emphasizes conceptual understanding and applications. Reading of current newspaper articles and exercises involving personal finance are incorporated to place mathematics in real-world context.

Prerequisites for the course include a level of proficiency in reading and a C or better in Math Literacy for College Students (Math 095). Cut scores in Accuplacer were lowered to move more students out of Pre-Algebra and into Math Literacy for College Students. Students scoring into Pre-Algebra via Accuplacer were enrolled into Math Literacy and a supplemental one-credit hour support course.

The primary methods of instruction used throughout this course are lecture and discussion with many opportunities for questions, small group work, and the use of MyLab Math software and Microsoft Excel. Students are required to write out problem solutions and articulate their understanding in writing.

## Challenges and Goals

After spending about four years attempting to internally improve the relevancy of the algebra sequence, a committee comprised of community college and university representatives worked from January 2012–January 2014 to revise the long-standing [Michigan Association of Collegiate](#)

[Registrars & Admissions Officers](#) (MACRAO) agreement. After much deliberation and input from institutions, the committee submitted [final math recommendations](#) for the new Michigan Transfer Agreement (MTA). Essentially, the final report stated that Intermediate Algebra could not count as a college-level course, and that students should have different options, or tracks, they could choose based on their major: Quantitative Reasoning (aka Liberal Arts Math), Statistics, and College Algebra.

Given these recommendations, Peter Brown and Chris Bendixen, from Lake Michigan College, set about creating a course that would develop students who are competent in the mathematics that they need in their everyday lives. While student success would ultimately be measured by passing the course, Brown, whose background is in curriculum, wanted to ensure that in order to pass it, they must put in effort which he hoped would produce better critical thinking skills and teach them to persist in their efforts.

Brown went through one semester without a textbook while he and Bendixen tried to create their own Quantitative Reasoning approach. “I gave myself somewhere around a C minus for my efforts,” Brown says. Then he heard that Eric Gaze would be giving a talk about Quantitative Reasoning, which he listened to and saw how much Gaze understood about the course and its issues. After the talk, Brown decided to adopt Eric Gaze’s QR program developed inside MyLab Math, hypothesizing that students could learn the basic quantitative skills outside of class and the reasoning skills in class through group work and activities.

## Implementation

Brown strongly feels that a good course begins with the instructor. Because many adjuncts teach the course, he requires them to register in MyLab Math as a student through their school’s learning management system (Canvas) account and work through the course as a student. In this way, he hopes, instructors will be familiar with MyLab Math and well aware of what their students will be doing in the course.

Instructors use guided worksheets during lecture and students fill out the answers while taking notes. These worksheets can be found within the MyLab Math online course and are also available as a separate workbook that students can purchase. Instructors are expected to explain the material and lead group discussions that are found within the worksheets. On average, instructors spend about 30 percent of the class period lecturing on the topic of the day and then spend the rest of the time facilitating discussion and group work.

The course covers approximately one chapter every two weeks, and one MyLab Math homework is assigned per topic. The assignments are mostly skill-based but also contain some reasoning questions. Fewer problems are assigned because it takes students a little longer to work through them. In addition, Brown assigns Additional Excel Problems (AEPs) to his students which must be graded by hand. He finds this to be a relatively easy task as students upload their files through Canvas.

Late work is allowed within one week of the due date with a valid excuse, and students are expected to spend about 90 minutes to two hours per week on MyLab Math homework problems. Brown’s syllabus explicitly states that the students are “expected to struggle” and ask for help and that math is “learning by doing.” Brown stresses to students that homework is the most important part of the course.

Short chapter quizzes are given on the material covered in the homework assignments and in class. Short Excel quizzes are also embedded into the assessments. Make-ups are allowed with a valid excuse within one week of the original quiz. There are two different types of quizzes for each chapter: the first is a written, in-class quiz on the quantitative skills covered in the homework (about three or four questions given after every chapter), and the second is a take-home quiz on the readings. Students are expected to contribute questions to the readings on which they are graded.

Students also complete two to three projects throughout the semester. One example of a student project involves dependency ratios and the stock market. Students are given a set of questions that they must answer and then turn in as a written report. These projects are supplied by Gaze as part of the MyLab Math course. Projects incorporate critical thinking, communicating effectively with numbers, and reading and writing for meaning.

Given Brown's desire for students to struggle with and persist through the material, his syllabus explains how to be successful in the course. The following is an excerpt from the syllabus portraying his views: "The single biggest obstacle to success in anything (not just this math class) is how willing you are to participate and persist in the endeavor. Your mere presence in the classroom, while necessary, is far from sufficient for success. You must learn to be Present with a capital P. Boredom and dislike are states of mind that can be changed! The following five states of mind (AEIOU) should be cultivated at all costs, and all negative thoughts about this course and its possible outcomes should be banished:

- Be Active in all parts of the learning process from the classroom to homework.
- Be Engaged in what others are saying and in what you are doing.
- Be Interested—it is so much more fun than being bored.
- Be Observant, and reflect on what you see; ask questions as much as possible.
- Be Uplifting toward others and yourself.

In addition, the following three math *faux pas*<sup>1</sup> should be avoided:

- Students expect and often ask to be told the procedure to solve problems.
- Students ask for help on problems without first making a serious effort to solve them on their own.
- Students are reluctant to ask questions about the motivation for the content presented and the reasoning behind their teacher's and classmates' assertions."

## Assessments

- 30% Quizzes
- 20% MyLab Math homework
- 20% Microsoft Excel problems and quizzes
- 20% Exams (two at 10 percent each)
- 10% Project

## Results and Data

Brown maintains that Gaze's curriculum is acting as the vision for the course moving forward. He believes that some colleges are struggling with "what to do" because their concentration is on

objectives, which Brown argues should be secondary to a vision, and the vision at its core should be about critical thinking and reasoning with numbers.

Pedagogy makes a big difference in the QR course. According to Brown, the success rates for the course vary greatly and a lot of times depend on the section instructor. To assess student learning, the department agreed with Rita Carwell's belief early in the process: "We do not really know if we are making progress [since]...we do not have genuine benchmarks for what constitutes quantitative literacy." (quoted in Steen 2004, p. 57<sup>2</sup>) As a result, student learning is assessed using a non-proprietary instrument developed for this purpose called the [Quantitative Literacy and Reasoning Assessment](#) (QLRA)<sup>3</sup>. The NSF-supported QLRA project synthesizes and builds on the experiences at Colby-Sawyer, Bowdoin, and Wellesley Colleges. Brown states, "A QR course isn't promoting a skill set around the umbrella of proportional reasoning, as much as promoting a way of thinking, which is what makes this course hard to measure." Thus, when Brown found this testing instrument, he realized it was a good, fair way to measure the success of the course and compare against other students across the nation who took the same exam.

Figure 1 illustrates that Brown's course performance is stronger than the national average ( $M=7.5$ ,  $SD=3.8$ ), with students improving from a mean score of 5.7 on the QRLA pre-test that is given to them upon enrolling in the course ( $SD=2.5$ ) to a mean score of 9.3 on the QRLA final exam, given the last day of the course ( $SD=3.0$ ).

### QRLA test scores

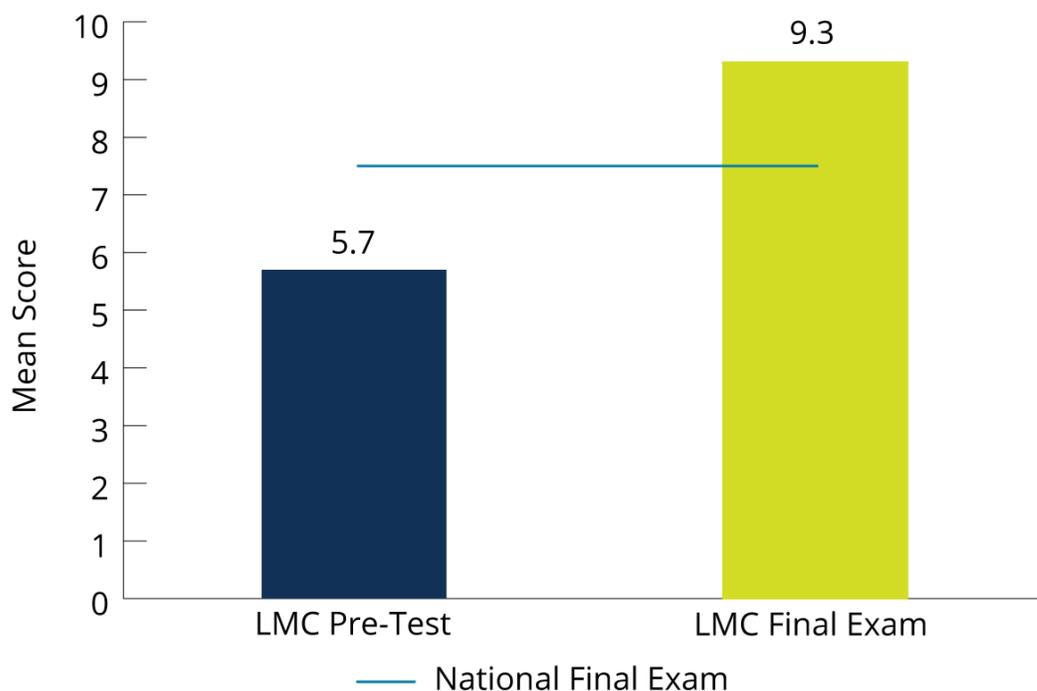


Figure 1. Students' Mean Scores on the QRLA, Fall 2013–2016; LMC ( $n=455$ ), Nation ( $n=7,000$ )

After three semesters of using Gaze's materials, the decision was made by the Math Department at LMC to eliminate about 90 percent of the sections of the course below Math Literacy, commonly

referred to as Pre-Algebra. In their opinion, Pre-Algebra represented a futile attempt to begin the process of reviving a STEM track for students testing in at a ninth grade or below algebra level. “There is a rumor,” Brown jokes, “of one known case in 1958 whereby a student started in 090 Pre-Algebra and eventually received a Math minor.” Still, on-ramping to a more traditional math sequence is probably strengthened by the school’s focus on numeracy and critical thinking, Brown maintains.

Brown believes a large part of the reason they have been able to adapt so quickly has been the cohesion within the Math department and the support from the Vice President of Academics.

## The Student Experience

“Everybody should have to take this course—it’s stuff you’re actually going to need.”

Brown reports that students who engage with him and the course materials love the course; likewise, ones that don’t engage don’t do well. One student wrote in a course evaluation, “Everybody should have to take this course—it’s stuff you’re actually going to need.”

In addition, Brown feels the use of spreadsheets in analyzing large sets of data gives students a perspective and an opportunity they mostly have never before experienced. “It is often a powerful, liberating experience for them,” he states. “Of course, underlying the use of spreadsheet is algebraic reasoning, although we don’t call it that.”

Finally, Brown has noticed that students struggle with the course because they have a habit of just trying to churn out equations. He states, “The students aren’t coming in prepared in the right way. The fact that students can do  $2x=6$  doesn’t really help them in this course. They have to think critically and they have to be able to do things that aren’t just memorized.” He continues, “Twenty to twenty-five percent of our students could go to any college but the overwhelming majority of our students have many more deficiencies than we ever thought.” According to Brown, most students struggle with fundamental numeracy concepts and with reading higher-level news articles and interpreting data in those articles. Thus, Brown and his colleagues have incorporated more reading and writing into the course to help students read and answer questions carefully.

## Conclusion

“This is a teacher’s course because you get to teach real problems, not algorithms.”

Based on LMC’s students’ results on the QRLA—both the improvement from pre- to post-test (3.6 points/63 percent higher) and compared to national results (1.8 points/24 percent higher)—Brown believes the course meets his goal of one where students learn computational skills outside of class and practice reasoning skills in class. He maintains that the Gaze program in MyLab Math has made it possible.

Until one teaches a QR course, Brown doubts anyone will appreciate how essential the course is. “I also doubt other math instructors will appreciate how fundamentally lacking most students—yes, even students who took AP calculus in high school—are when it comes to utilizing the everyday math skills they ‘learned’ in middle school,” he states. He maintains that very few students can find a percent increase, fewer can utilize a ratio table, not many can extract essential mathematical content from newspaper articles, and few coming into the class can communicate effectively with numbers. “Students have been trained to look for a procedure and get the right number. Often this course is about developing insight, not finding the right number. This is difficult for students.” In addition, Brown believes the Gaze MyLab Math program has allowed him to create a course he loves teaching. “This is a teacher’s course because you get to teach real problems, not algorithms.” According to Brown, “Algebra is complex mathematics but simple reasoning; quantitative reasoning is simple mathematics but complex reasoning. It’s a fun challenge to help students understand the complex reasoning.”

The next step in the process for LMC is to partner with local area high schools and, instead of students not taking any more math classes while in high school, expose those students to a pre-QR curriculum so that there is no need for remediation once they enter college. According to Brown, students need to be exposed to a deeper level of thinking than a traditional beginning algebra course offers, which, he says, “most students have seen many times and really have no idea what it is, or why they have to take it...again.”

Thus, Brown explains that because of the success they had with the Gaze curriculum, LMC has replaced its Introductory Algebra course with Math Literacy for College Students. The Math department at LMC feels that Math Literacy incorporates enough algebra for a student to on-ramp to a more traditional math sequence, but also realizes the overwhelming majority of students entering at this level are not going to be STEM majors. Brown maintains that these students fundamentally lack the tools to navigate quantitatively in the real world and need support through a course that makes sense for them.

Another planned project is to examine the testing placement process and most likely move to a multiple measure process that would combine high school GPA and SAT scores.

1 G. Harel, J. Rabin, Teaching Practices Associated with the Authoritative Proof Scheme, *Journal for Research in Mathematics Education*, Jan 2010, Vol. 41, Num. 1, P. 16

2 Steen, L. A. 2004. Achieving quantitative literacy: An urgent challenge for higher education. Washington D.C.: The Mathematical Association of America.

3 Gaze, Eric C.; Aaron Montgomery, Semra Kilic-Bahi, Deann Leoni, Linda Misener, and Corrine Taylor. “Towards Developing a Quantitative Literacy/Reasoning Assessment Instrument.” *Numeracy* 7, Iss. 2 (2014): Article 4). DOI: <http://dx.doi.org/10.5038/1936-4660.7.2.4>