

# College-High School Partnerships in Implementing Large-Scale Innovation in Entry-Level Math Education

Patrick Mayers, About H. Cherif, and Steve Dorfman

## Introduction—The Opportunity

A college (DeVry University) has achieved a breakthrough (summarized below) in student success in entry-level mathematics. It has been pursuing an opportunity to share its success with local high schools. The perceived value to the college is building relationships of mutual trust and regard with local high school administrators, teachers, parents, and students. In this initiative, the college seeks to give back to local communities, and it also hopes that, over time, there will be modest increases in enrollments of students interested in DeVry's career-oriented degree programs (at the associate's, bachelor's, and master's levels) in business, technology, and health care, with stronger entering students who will retain at higher levels, complete their programs, and get good jobs in their fields of study.

## The Breakthrough

First, the problem, which is simple to state, but it is pervasive and, heretofore, intractable: a large number of entering students who are weak in arithmetic and elementary algebra, who do not succeed (defined as student performance, satisfaction, and retention) in entry-level mathematics courses, despite excellent and highly dedicated teachers. The effect is waste: waste of human potential (in our students), loss of revenue to the institution (tuition from thousands of students each year), expense (of faculty time and salaries), and frustration (of students, faculty, and academic leaders).

The solution to the problem, the breakthrough, is also easy to state, but its successful implementation has required creative, out-of-the-box thinking combining new technology and old pedagogical insights, support from senior management, faculty leadership and training, and focus, focus, focus on the details. The breakthrough? Self-paced mastery learning supported by a new generation of Web-enabled math software. We are using Pearson Education's MyMathLab (MML), standard courses collaboratively designed, developed, and managed by a course architect and supported by a team of math faculty members, with all faculty members delivering the same courses (including content and level, homework, exams, and sequencing).

Within each course, there is a common pattern of engagement of the individual learner: (1) Each chapter begins with a pretest. (2) The results of the pretest generate an individualized study plan for each student. (3) The study plan is broken down by section. (4) Each section is further broken down by individual objectives. (5) For each objective and problem type, the student is offered a variety of instructional supports (including short videos, demonstration problems, and simulations, with stepwise solutions, access to the most relevant text pages via the eBook). (6) Access to the instructor is available via e-mail or a special Pearson tutoring service by phone for out of class support. Each student selects instructional supports that are most compatible with his or her learning style. (7) Every time a student takes either a pretest or a graded test, a new study plan is produced. (8) Homework and test questions are generated algorithmically, and the order of the test questions can be shuffled, if desired, each time a test is selected.

The role of the instructor changes fundamentally, as captured neatly by an unknown wordsmith, "from the sage on the stage to the guide on the side." The faculty member assumes the role of coach or tutor or "enabler." Moreover, students are encouraged to help one another (except during exams). Responsibility for learning is placed on the students (which they enthusiastically embrace in the self-paced mastery learning environment). The MML platform supports the new role of the faculty member by generating all study plans; checking all sample problems attempted; grading all homework and tests; keeping the students on track (by enforcing the built-in sequence and level of competencies); and providing students with constant feedback on their progress or lack thereof. Where the instructor identifies (through the grade book) several students struggling with the same concept or problem type, the instructor pulls the group together for a mini-lecture/demonstration (typically fifteen to twenty minutes).

(For more detail on the breakthrough see the reference at the end of the article.)

## A High School Partnership

In the state of Washington, the Department of Education administers the Washington Assessment of Student Learning (WASL) test each year to students in selected grade levels. The high school exam is administered to students in the tenth grade. Beginning with the 2006 administration of the WASL, students must earn passing scores to receive their high school diplomas. That is, effective with the graduating class of 2008, students must demonstrate proficiency in the learning requirements assessed by the state of Washington to graduate from high school. Students who do not pass the test in the first attempt are allowed up to four retakes of the exam to earn passing grades.

In collaboration with the local superintendent and his staff, the DeVry president, dean of academic affairs, and their team developed a plan to invite all students from the local high school district who did not pass the WASL to participate in a DeVry-developed math course that combined DeVry's mastery learning pedagogy with the MML platform. Our joint goal was to prepare the students for a retake of the mathematics portion of the WASL. The course was designed by the head of the DeVry math team and was tailored to the WASL curricular requirements; the coverage was essentially arithmetic with some geometry and measurement. The course covered the first six chapters of the mathematics textbook *Developmental Mathematics*, Sixth Edition, by Bittinger and Beecher. The students were required to obtain an overall grade of 70 percent or higher to pass the course. This grading standard was chosen to agree with current state requirements.

For the summer 2006 term, we offered three sections of the WASL course to the Federal Way High Schools. The three sections were mornings from 10:00 to 12:00, afternoons from 1:00 to 3:00, and evenings from 4:00 to 6:00 on Monday to Friday for six weeks. Students came to the DeVry campus for the MML course. Classes started on June 26 and ended on August 4, with July 3 and 4 off for the Independence Day holiday. The dates were picked so that the course would be finished in time for the next offering of the statewide assessment test on August 8. The classes were taught by a full-time DeVry math faculty member experienced in MML and the DeVry methodology, with the support of a faculty assistant (FA). The total cost of this project to DeVry was about \$10,000.

The initial enrollments were twenty-eight in the morning class, twenty-five in the afternoon class, and eight in the evening class, for a total of sixty-one students participating in this program. This is roughly 30 percent less than the DeVry recommended attendance of eighty-five students to have three full classes. The school district made every effort to meet this objective, but the actual attendance reflected cancellations by some of the original enrollees. The students who participated all reported enjoying the course. If they were successful in the course, they received both high school credit and DeVry credit.

Of the sixty-one students from all five of the local high schools initially enrolled in the course, forty-five students, or 73.77 percent, completed and passed the course with a grade of C or better. The statistics by section are morning: eighteen of thirty-two or 56 percent passed; afternoon: twenty of twenty-two or 91 percent passed; and evening: seven of seven or 100 percent passed (the enrollments by class differ because four students had switched classes). To the local administrators and faculty, this overall pass rate for some of their weakest students in math was a very strong and positive result. As of the writing of this article, no data exist to determine whether the students who passed the DeVry course were successful on the retake of the state mathematics assessment test. The school district will share these data when they become available.

Of the forty-five students who passed the WASL review course, sixteen students finished early enough to enroll in MATH-032 (the follow-on DeVry course that focuses on elementary algebra) and continue their education. Eight of the sixteen students, or 50 percent, successfully completed MATH-032 and will receive DeVry credit for MATH-032 if they later enroll at DeVry. The students had to satisfy the standard DeVry requirement for MATH-032 of an overall grade equal to 80 percent or better.

Lastly, of the eight students who successfully completed MATH-032, six students chose to continue in MATH-092 (the follow-on DeVry course that combines elementary and intermediate algebra topics). One of the six students enrolled in and successfully completed MATH-092. No student progressed far enough to be enrolled in MATH-114, DeVry's intermediate algebra course.

## Challenges and Improvements

While overall the school district and DeVry felt that the program was a resounding success, there were a few operational snags in this first implementation. At the last minute, several issues arose that were not anticipated either by DeVry or the local administrators with whom we were working. Although the school district was not being charged for the course, the school district treated DeVry as a subcontractor. Hence, the school district expected DeVry to abide by all the rules and restrictions its subcontractors must follow. As other MML review courses are held in the future, in Washington or elsewhere, we will be more careful to clarify and plan for local legal and administrative requirements up front.

In particular, this time, the school district expected all DeVry employees who would come into contact with the students to have undergone FBI background checks and to have been fingerprinted. While this was an entirely reasonable request, DeVry was notified about it

only forty-eight business hours before the course was to begin, and it put considerable additional pressure on the DeVry team. Another, also understandable, request that we were able to satisfy was to post notices outside of the classroom(s) used by the students about sexual offenders in the local area.

## Additional High School Math Outreach Initiatives Underway

The following additional MML outreach initiatives are underway proximate to other DeVry campuses. They utilize the same model but are adjusted for local requirements:

- In Chicago, we are partnering with American Quality Schools, a contract provider of alternative inner-city schools, to set up an MML classroom at Austin High School. In this case, DeVry has tailored the course to meet Chicago Board of Education curricular requirements and has trained one of the school's math faculty members to conduct the course. Pearson has agreed to provide, at no charge, the MML software installation and technical support.
- In Addison, Illinois, DeVry's DuPage campus president has a long-standing collaborative relationship with a local superintendent, and they are jointly sponsoring an MML implementation and offering both at the campus and in one of the schools.
- In Arlington, Virginia, DeVry's Crystal City campus is partnering with McKinley High School, an inner-city technology magnet school, to offer the MML courses at the school. They are currently working out bandwidth issues (the MML courses are delivered via the Internet).
- In Phoenix, Arizona, DeVry's academic team is planning to include the MML courses in its summer 2007 Passport to College program (a summer offering of selected DeVry courses for high school students).
- In Long Beach, California, the campus leadership is working with the local school district to replicate the Federal Way, Washington, offering.

## In Conclusion

The need for improvement in the teaching of entry-level mathematics is great, and the stakes, for the country, are high. We have demonstrated that self-paced mastery learning used in conjunction with state-of-the-art interactivity (MML) significantly and substantially improves student success, and that it is a scalable educational innovation. The challenge, and the opportunity, that this paper explores is how to reach out beyond our institution to engage in partnerships that will multiply and deepen access to success in entry-level mathematics for students, their families, faculty, and schools. We would like to emphasize what our experience has taught us are the keys to success: (1) teacher and faculty development and training in technology, pedagogy, and content; (2) teacher and faculty belief in and commitment to the use of technology to enhance student learning; (3) full commitment and support from the institution, academic leaders, and upper management team; and (4) academic policies and procedures that provide academic quality assurance to which all participants are expected to adhere.

## Note

For further information on the methodology and results, see "Achieving a Breakthrough in Student Success in Entry-Level Mathematics" by Patrick Mayers, Abour Cherif, Steve Dorfman, Bashar Hanna, Jennifer Harris, and Susann Kyriazopoulos, presented at the 2006 Higher Learning Commission Annual Meeting, Chicago, Illinois, April 3, 2006, and published in *A Collection of Papers on Self-Study and Institutional Improvement 2006*.

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*Patrick Mayers is Professor of Statistics, Senior Vice President of Academic Affairs, and Dean of Keller Graduate School of Management at DeVry University in Addison, Illinois.*

*Abour H. Cherif is Director of Curriculum for Math and Science at DeVry University in Addison, Illinois.*

*Steve Dorfman is Associate Director of Curriculum for Mathematics, National MML Curriculum Manager at DeVry University—Ft. Washington, in Ft. Washington, Pennsylvania.*

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