

## INCREASING SUCCESS IN DEVELOPMENTAL MATH: FOLLOWING THE NCAT PLAYBOOK

by  
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In the [October 2007](#) and [January 2008](#) issues of *The Learning MarketSpace*, we described the Developmental Studies Redesign Initiative launched by the Tennessee Board of Regents (TBR) to reform its remedial and developmental math and English curriculum. Its goal is to develop and implement a more effective and efficient assessment and delivery system that will increase completion rates for students, reduce the amount of time that students spend in remedial and developmental courses, and decrease the amount of fiscal resources that students dedicate to remedial and developmental education.

Tennessee is not alone in dealing with the issues of remedial and developmental education. A September 2008 report “Diploma to Nowhere” ([www.edin08.com/diplomatonowhere.aspx](http://www.edin08.com/diplomatonowhere.aspx)) issued by the advocacy group, Strong American Schools, estimates “conservatively” that 43% of students at two-year colleges and almost 30% of students enrolled in four-year public institutions nationwide have taken a remedial course, costing an annual \$2.5 billion.

The TBR is partnering with NCAT to develop new delivery structures by building on the successful models and lessons learned from NCAT’s Program in Course Redesign. The new models will streamline course delivery, leverage new learning technologies, increase the quality of learning and reduce the cost of instruction. In order to address the problems identified by the TBR and its member institutions, it became clear early on that modularizing the curriculum would be a key strategy. The development of better placement systems combined with shorter, more tailored remedial and developmental modules would enable students to save time and money by only enrolling in the modules that address their deficiencies.

Preliminary results from the TBR initiative are very positive. In this article, we will focus on the achievements at Cleveland State Community College, a two-year institution in southeastern Tennessee. While many good things have happened in a very short time period in Tennessee (the six TBR redesign projects have piloted their redesign plans during spring and fall 2008), the scope and accomplishment of Cleveland State’s redesign are truly extraordinary.

### **Cleveland State Community College**

Cleveland State Community College enrolls approximately 2,100 FTE and 3,100 headcount annually. The college is redesigning its developmental math program, which consists of three courses: Basic Math, Elementary Algebra and Intermediate Algebra. These courses have historically been offered primarily in a traditional lecture format, enrolling over 1200 students annually with ~200 students in Basic Math, ~500 students in Elementary Algebra, and ~500 students in Intermediate Algebra. Drop-Failure-Withdrawal (DFW) rates have averaged 45% in these courses. Elementary Algebra has presented the biggest obstacle to student success, often having DFW rates of more than 50%.

Cleveland State has redesigned these three math courses using the Emporium Model pioneered at Virginia Tech and replicated at many additional institutions. At CSCC, students meet one hour in class and two hours in a large computer lab. The one-hour class meetings are held in small labs (20 computers). Instructors do not lecture during class meetings. Instead, students work

online and instructors help students individually. Instructors also review student progress and help students with their action plans for the coming week.

The large computer lab is available 54 hours per week to allow students to work at their convenience. The lab is staffed by instructors and peer tutors to provide individualized assistance to the students. The course material is organized into 10 to 12 modules, which students complete at the rate of one or more each week. All homework and testing is done online. Quizzes on each module can be re-taken multiple times until students display mastery. Students have the option of completing more than one module each week—i.e., they can move through each course at an accelerated pace. Students who complete a developmental math course before the end of the term are allowed to begin the next developmental course immediately.

### **The Impact of Redesign on Student Learning**

As you read about these results, keep in mind that the first pilot of Cleveland State's redesign occurred in spring 2008, only one year ago. Preparations for implementing the redesign occurred during summer and fall 2007. In addition, most NCAT redesigns focus on one course; Cleveland State simultaneously redesigned three developmental courses plus an additional three college-level courses. Finally, during this period Cleveland State experienced the usual start-up problems that occur with any large-scale redesign (technology glitches, registration problems, etc.) yet still produced outstanding results. This suggests that student achievement can increase even more as the redesign matures.

#### Student Learning Outcomes

Cleveland State assessed student learning outcomes by comparing common content items from selected departmental final exams administered in the traditional format during the previous five years to the redesigned sections in spring and fall 2008.

- In Basic Math, the number of common test items answered correctly increased from 73.3% to 86.2% in fall 2008.
- In Elementary Algebra, the number increased from 70.3% to 86.2% in spring 2008 and 83.8% in fall 2008.
- In Intermediate Algebra, the number increased from 77.3% to 90.1% in spring 2008 and 88.7% in fall 2008.

#### Course Completion Rates

Prior to the redesign, an average of 55% of students taking any developmental math course at Cleveland State earned a final grade of A, B or C. After the redesign during fall 2008, 72% earned an A, B or C, which represents a 31% increase in course completion rates.

- *Basic Math*: Course completion rates improved from 52% to 65%, and the average grade increased from 1.92 to 2.53. Students in Basic Math were required to do a mountain of work, with the average student performing more than 1,000 exercises in the semester. This amount of work will serve to better prepare the students for success in their future math courses.
- *Elementary Algebra* : Course completion rates improved from 52% to 70% in spring 2008 and 67% in fall 2008, and the average grade increased from 1.95 to 2.88 and 2.63 respectively.
- *Intermediate Algebra* : Course completion rates improved from 56% to 71% in spring 2008 and 79% in fall 2008, and the average grade increased from 2.02 to 2.85 and 3.20 respectively.

### Program Completion

The developmental math program consists of all three courses. Prior to the redesign, an average of 56% of students (N = 182) successfully exited the developmental math program. After the redesign during fall 2008, 268 students successfully exited the program, a 47% increase in moving students through developmental studies to college-level math courses.

### Developmental Math Student Performance in College-Level Courses

One of the most important measures of success for any developmental math program is how well students perform in subsequent college-level math courses. Students at Cleveland State who took the redesigned developmental math courses primarily in spring 2008 were tracked to see how they performed in three college-level math courses during the fall semester.

The students who took the redesigned developmental math classes outperformed other students on every measure. Before the redesign, the completion rate of developmental students in college-level courses was 71% compared to a completion rate of 70% for other students. After the redesign, the completion rate of developmental students in college-level courses was 81% compared to a completion rate of 70% for other students. Redesign students also had higher average course grades (3.15 compared to 2.94). This is the first time developmental math students have done better than the other students at Cleveland State, and by a wide margin. These results suggest that the students exiting the redesigned developmental math program have been truly prepared to succeed in their college level math classes.

The increase in success cannot be attributed to “easier courses” as the overall success rates in the three college-level courses remained virtually unchanged at about 72% overall. In examining performance in the college-level courses individually, the Cleveland State team found that developmental math students performed equal to or better than the other students in each of the three courses. The developmental math students not only caught up to the other students in performance, but actually surpassed them.

### Increased Student Success in College-Level Math Courses

Finally, the number of Cleveland State students enrolling in and passing a college-level math course during fall 2008 increased by 15% compared to the average of the past five years. During fall 2008, 281 of 391 students enrolled in and passed a college-level course vs. 245 of 340 students, the average of the previous five years. This is the result of higher enrollment in college-level courses rather than the result of higher passing rates, which overall remained at about 72%. This higher enrollment is due in large part to the increase in success rates in the developmental math program and the ability of students to exit the developmental math program and complete a college-level class in the same semester. More students completed Intermediate Algebra, the third course in the developmental sequence, in spring and summer 2008 than in previous years.

With a 47% increase in students exiting developmental math, the increase in enrollment in college-level courses should continue, and enrollment numbers for spring 2009 confirm this expectation. Enrollments in College Algebra, Introductory Statistics and Finite Math have increased from an average of 320 students in previous spring semesters to 480+ in the current term, an increase of approximately 50%.

### Mobility within the Developmental Math Program

The traditional TBR developmental course sequence did not afford an opportunity for students to quickly get up to performance level in one stage so that they could move to the next stage sooner. Students were required to take an entire course even though they may have only been

deficient in a portion of the topics. All students were required to learn at the same pace and with the same instructional strategies as the entire class.

Because learning in these skills-based courses occurs in specific increments and the time required to master each increment varies from person to person, the current three-course system lacked the flexibility that can lead to greater student success. Thus, an important goal of the TBR initiative was to allow students to start anywhere in the developmental course sequence based on their learning needs and progress through the content modules at their own pace, spending the amount of time needed to master the module content, proceeding at a faster pace if possible or at a slower pace if necessary.

At Cleveland State, students now have the option of completing more than one module each week—i.e., they can move through each course at an accelerated pace. Students who complete a developmental math course before the end of the term are allowed to begin the next developmental course immediately.

What has been the impact of this change at Cleveland State?

- 37 students completed two or more developmental math courses in one semester, and 33 of these exited the developmental math program after one semester.
- 9 students completed Intermediate Algebra and a college-level math course in the same semester.
- 2 students completed three courses in one semester, each completing over 1800 exercises.

### **What's Behind This Incredible Achievement?**

Consistent with past successful NCAT redesigns in math, the Cleveland State team has identified a number of factors that have contributed to the success of their redesign project:

- *Student Engagement (Time on Task)*: The first, and most important, reason is that students are simply doing more work in the developmental math program than before. As a redesign team at another community college correctly observed, “The primary reason many students do not succeed in traditional math courses is that they do not actually do the problems. As a population, they generally do not spend enough time with the material, and this is why they fail at a very high rate.”

Students in the redesigned courses had to work harder than ever in order to be successful. Cleveland State students spent over 19,000 hours in the math labs and 12,000 hours in the classroom, while logging thousands of additional hours at home. In order to pass each course, students were required to watch videos and take notes, complete each homework set and pass every quiz and exam, a mastery learning approach that guaranteed that students would be successful as they moved forward.

- *Continuous Enrollment*: The continuous enrollment approach at Cleveland State is clearly a success. Students were able to complete two courses in one semester or complete one course and start in the next course in the same semester. Many students have taken advantage of this option as evidenced by 46 students completing more than one course in a semester.
- *Curricular Changes*: Changes were made in the developmental math curriculum to place greater emphasis on topics like graphing, rounding and technology, thus better preparing students to move to the next level of math study.

- *Overcoming Math Anxiety:* Many students exiting the developmental program have overcome their fear of math through the volume of work they have done. The initial results of the redesign in developmental math show the potential of the new courses to better prepare students for success in college.

### **The Impact of Redesign on Reducing Costs**

As of fall 2008, Cleveland State's redesign has produced an annual savings of more than \$50,000. This is a result largely of shifts in personnel as described below. Other savings include lower copying costs due to online homework and testing. This figure represents a significant savings for a department of eight faculty members and one staff member.

- *Increased Faculty Productivity:* Faculty productivity rose by 23% in fall 2008. The use of technology has decreased the amount of course preparation and delivery time spent by full-time faculty members on these courses. The average student load per faculty member went from 106 to 130. The FTE teaching load per faculty member went from 21.2 to 26.0. Five of the eight faculty members had student loads of 150 – 175 students. This increased productivity enabled the department to eliminate the use of adjunct faculty members while increasing course offerings.

Faculty members were initially expected to teach 10 course sections and work in the lab 10 hours. It is now clear that teaching 11 course sections and working in the lab 8 hours is another possible arrangement. Cleveland State does not expect faculty members to move beyond this range since there is a limit to how many students a faculty member can manage and still give students the individual attention that they need in order to be successful. As the team moves forward, faculty members will be expected to teach 10 - 11 sections, work 8 – 10 hours in the lab, and handle 150+ students each semester.

- *Lab Staffing:* Staffing the Cleveland lab shifted from a full-time staff position to five part-time tutors in addition to the full-time faculty members. Also, one volunteer worked in the lab 5-6 hours each week. Ways to gain additional volunteers from the community and a local four-year college are now being explored. The department is optimistic that the volunteer portion of the lab staff will expand slightly in future years. At the Athens lab, one staff member was hired to replace a retiring faculty member.
- *Low-Enrollment Sections:* Based on what they have learned from the redesign, the Cleveland State math department will try a new approach to low-enrollment classes starting in spring 2009. They will offer multiple courses in the same classroom at the same time. The strategy will be used at the Cleveland campus during class times that have had historically low numbers. This new strategy will also enable the department to increase course offerings in several courses. When the redesign project is expanded to include Basic Calculus and Precalculus in fall 2009, for example, this new strategy will enable those courses to be offered at the smaller Athens campus for the first time in many years. This, in turn, should reduce scheduling roadblocks for students and enable them to complete their degree requirements sooner.

The primary goals of the redesign project were to increase success rates in the developmental math program, better prepare these students for success in college and increase the ability of students to move quickly through the developmental math program, removing the roadblocks to success. All of this was to be done with an eye towards producing actual cost savings. So far, the project has been an overwhelming success.

### **What about College-Level Math Courses?**

During the same year, Cleveland State has also redesigned three college-level courses: College Algebra, Finite Math and Introductory Statistics. These redesigns have also achieved impressive results:

- *College Algebra*: The course completion rate increased from an average of 65% over the past five years to 74% in fall 2008. The improvement in the success rate is promising, as the passing rate had never been above 70% in the last five years. The course GPA increased from 2.26 over the past five years to 2.89 in fall 2008, and the number of common test items answered correctly increased from 75.64% to 86.34%. The course is similar in both content and level of difficulty to what it has been in previous years.
- *Finite Math*: The course completion rate increased from an average of 75% over the past five years to 91% in fall 2008. This increase, while encouraging, is not as significant as it might appear. This is a low-enrollment course, with completion rates fluctuating between 70% and 90% in the past. This happens in low enrollment courses, since just a few students passing or failing can affect the success rate by as much as 10%. So, while the team is pleased with the success rate, the improvement should not be overstated.

The course GPA increased from 2.53 over the past five years to 3.63 in fall 2008, and performance on common test items increased from 82.1% to 87.5%. The course is similar in both content and level of difficulty to what it has been in previous years. The increases in performance are most likely due to the increase in student engagement as well as the mastery approach that is used in all of the redesigned courses.

- *Introductory Statistics*: The course GPA increased from 2.79 over the past five years to 3.04 in fall 2008, and performance on common test items increased from 79.6% to 83.3%. Given the expansion of the curriculum and greater difficulty of the course, it is safe to say these students learned more than students in past years.

The course completion rate decreased from an average of 79% over the past five years to 68% in fall 2008. This was likely due to the course being strengthened in terms of an expanded curriculum and increased difficulty level under the redesign. Faculty members felt the course was significantly harder than it had been in previous years. Some of the modules proved to be too time-consuming for students to complete in one or two weeks. Tweaking the course should eliminate the problems in the course, making it more acceptable to both faculty and students in future semesters.

### **What's Next?**

Cleveland State also plans to redesign three additional courses in spring 2009 and to implement those courses in fall 2009: Basic Calculus, Precalculus I and Precalculus II. Once these courses are offered under the new format, approximately 95% of the students at Cleveland State will be taking math courses in the redesigned format. John Squires, the project leader and math department chair, recognizes the advantages that can be realized when you look at department redesign as compared to course redesign. Economies of scale are more easily realized the bigger the redesign project is. Also, redefining faculty roles and duties as Cleveland State has done is easier to do when the entire department and most of its course offerings are involved in the redesign.

### **Implications for Others**

Clearly the implications for colleges and universities around the country of the outcomes produced by Cleveland State are substantial. By putting students first and organizing their redesigns around the individual needs of students rather than the convenience of institutions, this

pioneering institution is making a major contribution to improving the ways in which all of us help students prepare for college success and move more rapidly to degree completion.

I recently wrote to John Squires to congratulate him and his colleagues on their outstanding work. I said, "You guys are the poster children for how to do the right thing! You should be really proud." John's response: "Much of what we did is simply follow the NCAT playbook."

That playbook is the product of the hard work and dedication of many, many extraordinary faculty and staff around the country that are showing the way to address one of our country's most vexing academic problems. The message is simple: "Students learn math by doing math, not by listening to someone talk about doing math."