The National Center for Academic Transformation

HOW TO REDESIGN A DEVELOPMENTAL MATH PROGRAM BY USING THE EMPORIUM MODEL

VI. How to Reduce Instructional Costs

The traditional format of developmental math courses requires instructors to carry out all of the development and delivery aspects of a course on their own. The traditional format assumes that small classes are necessary in order to produce positive learning results because the instructor is responsible for all interactions. Responding to every inquiry, comment, or discussion personally; preparing lectures; and the hand grading of assignments, quizzes, and examinations are labor-intensive. Course redesign involves substituting technology for much of that effort, often with the assistance of different kinds of personnel. Making the substitutions discussed in the following sections enables each instructor to teach more students than before—and without increasing the workload.

Q: How can redesign lead to reduced instructional costs?

A: Redesigning a whole course eliminates duplication of effort on the part of instructors and creates opportunities for using alternate staffing patterns. Since the Emporium Model eliminates the number of lectures or other classroom presentations for which faculty members must prepare and present and instead replaces those formats with interactive learning resources, faculty time can be reallocated to other tasks either within the same course or in other courses, and faculty can serve more students. Moving away from viewing instructors as the sole sources of content knowledge and assistance and toward greater reliance on interactive learning materials offers many opportunities for reducing instructional costs.

Replacing hand grading with automated grading of homework, quizzes, and exams makes it possible to reduce the cost of providing feedback while improving its quality. Online weekly practice quizzes can replace weekly homework grading, and all grading and record keeping can be automated. Replacing time-consuming human monitoring of student performance with course management software makes it possible to reduce costs while increasing the level and frequency of oversight of student progress. Using instructional software also radically reduces the amount of time that faculty members typically spend in nonacademic tasks like calculating and recording grades, photocopying course materials, posting changes in schedules and course syllabi, sending out special announcements to students, and documenting course materials like syllabi, assignments, and examinations so that they can be used in multiple terms.

Q: How can we calculate the number of hours instructors will spend on the redesigned course compared with the traditional course?

A: NCAT has developed a Scope of Effort Worksheet (see Appendix D) to help campuses document that the number of hours faculty devote to the redesigned course will be the same as or fewer than those devoted to the traditional format of the course—even if class size grows or the number of sections that faculty carry increases. This is possible because the Emporium Model offloads to the technology certain tasks like grading and monitoring student progress. Explaining how this occurs and documenting the changes by using the Scope of Effort Worksheet allow redesign leaders to help others on campus understand the benefits of redesign for both students and faculty.

Q: Do cost savings equal saved instructor hours?

A: Planning for cost reduction as a part of redesign consists of two steps. The first is to complete the Scope of Effort Worksheet for the traditional and redesigned formats of the course, which lets you demonstrate how the number of hours spent by each person involved in the course can change. The second step is to translate those saved hours into one of NCAT's Cost Reduction Strategies described later. If you stop at the first step, you might create what NCAT calls *paper savings*. By *paper savings*, we mean savings that represent a workload reduction for individual faculty members or others but do not produce cost savings to the department or institution.

Reducing time spent by individual faculty members and others as displayed on the Scope of Effort Worksheet is an *enabler* that allows you to choose a cost savings strategy. For example, a faculty member or TA who spends half the time on the redesigned course that that faculty member or TA did on the traditional course could increase section enrollment or carry two sections without an increase in workload. That then produces real savings for the institution.

Q: Does it matter whether our developmental math enrollment is growing or remains stable?

A: If the course enrollment is relatively stable (and accommodating more students is not a goal), you must reduce the number of people involved in teaching the course and/or change the mix of personnel in order to produce cost savings.

If accommodating more students is a goal, you do not have to reduce the number of people involved in teaching the course in order to produce cost savings, although you can do this. You can reduce the cost per student (total resources devoted to the course/total course enrollment) by teaching more students with the same staffing.

Q: How can we restructure the course to reduce instructional costs?

A: There are three ways to restructure the course that will reduce costs.

1. Have each instructor carry more students by
   a. increasing section size or
   b. increasing the number of sections each instructor carries for the same workload credit.
2. Change the mix of personnel from more expensive to less expensive.
3. Do both simultaneously.

Each of these strategies can be used whether your enrollment is growing or stable. When enrollment is stable, cost reduction means fewer resources are devoted to the course. When enrollment is growing, cost reduction means more students can be served by the same resource base. In each case, the cost per student is reduced.

Q: Are there examples of having each instructor carry more students by increasing section size?

A: Here's a calculation showing how this works:

Stable enrollment: If your enrollment is stable, this will allow you to reduce the number of sections offered and the number of people teaching the course.

> *Traditional*: 800 students: 40 sections of 20 students each taught by 40 instructors. Student-faculty ratio = 20:1
> *Redesign*: 800 students: 20 sections of 40 students each taught by 20 instructors. Student-faculty ratio = 40:1

Growing enrollment: If your enrollment is growing, this will allow you to serve more students with the same number of people teaching the course.

> *Traditional*: 800 students: 40 sections of 20 students each taught by 40 instructors. Student-faculty ratio = 20:1
> *Redesign*: 1,600 students: 40 sections of 40 students each taught by 40 instructors. Student-faculty ratio = 40:1

Cochise College. Prior to the redesign, Cochise College offered 71 traditional sections of developmental math on the main campus, with an average section size of 21 students each. After the redesign, the average section size increased to 38 students. The increase in section size meant that each of 10 full-time faculty carried on average an additional 33 developmental math students each year. The percentage of full-time faculty teaching the developmental math sections increased from 53 percent in the traditional courses to 73 percent in the redesign. The cost-per-student declined from $351 in the traditional format to $306 in the redesign, a reduction of 13 percent.

Stark State College. Stark State reduced the cost of developmental math by increasing section size from an average of 24 to about 48 on the main campus and about 40 overall. A significant, 81 percent enrollment increase (from 4,400 to 8,000 students) occurred also, yet the total cost of offering the developmental math sequence increased by only 36 percent. Stark State also reduced the number of contact hours per developmental math course from four to three. In the traditional format, Stark State had had to pay an additional one hour per section, and faculty could teach only eight sections annually. In the redesign, faculty could teach nine courses per year as part of their load. Together, these two actions reduced the cost per student from $238 in the traditional format to $178 in the redesign, a decline of 25 percent.

Q: What are examples of increasing the number of sections that each instructor carries for the same workload credit?

A: Here's a calculation showing how this works:

Stable enrollment: If your enrollment is stable, this will allow you to offer the same number of sections and reduce the number of people teaching the course.

> *Traditional*: 800 students: 40 sections of 20 students each; instructor time spent per section = 200 hours; each instructor teaches one section for the same workload credit. Student-faculty ratio = 20:1
> *Redesign*: 800 students: 40 sections of 20 students each; instructor time spent per section = 100 hours; each instructor teaches two sections for the same workload credit. Student-faculty ratio = 40:1

Growing enrollment: If your enrollment is growing, this will allow you to serve more students with the same number of people teaching the course.

> *Traditional*: 800 students: 40 sections of 20 students each; instructor time spent per section = 200 hours; each instructor teaches one section for the same workload credit. Student-faculty ratio = 20:1
> *Redesign*: 1,600 students: 80 sections of 20 students each; instructor time spent per section = 100 hours; each instructor teaches two sections for the same workload credit. Student-faculty ratio = 40:1

Cleveland State Community College. In the traditional model, Cleveland State's developmental math program comprised 55 24-student sections in fall and spring, 45 of which were taught by full-time faculty (82 percent) and 10 by adjuncts (18 percent). Each course met three times per week. The total cost of the traditional course was $270,675. In the redesigned model, Cleveland State offered 77 18-student sections in fall and spring, all of which were taught by full-time faculty at a cost of $219,258. Each section had one class meeting per week in a small computer lab, and students were required to spend two additional hours in a larger lab staffed by faculty and tutors. The total cost savings was $51,417, a 19 percent reduction. The full-time-equivalent teaching load per faculty member went from 21.2 to 26.0 with no increase in workload. Faculty had been teaching five sections per semester. In the redesign, faculty members taught 10 or 11 sections, which met once per week, and worked 8–10 hours in the lab.

Pearl River Community College. Pearl River Community College realized significant cost savings as a result of redesign. As part of the redesign, full-time faculty workload changed. Pearl River increased the number of developmental math sections taught by full-time faculty each term from five to nine for the same workload credit and reduced section size from 24 to 20. The student load for each instructor increased on average from 134 students each term to over 160 students. In addition, faculty worked five hours weekly in the lab with no change in the overall hours devoted to developmental math. The redesign format allowed one instructor to teach more students than were taught in the traditional format while decreasing class size. In the traditional format, each instructor taught five 3-day-a-week sections with 24 students. In the redesigned format, that same instructor could teach 10 sections of 20 students plus spend five hours tutoring in the lab. This could be accomplished because the class met only once a week and because no hand grading was required. Overall, faculty productivity rose by 31 percent, and cost per student decreased from $252 in the traditional format to $168 in the redesign, a 33 percent reduction.

Q: What are examples of changing the mix of personnel from more expensive to less expensive?

A: Here's a calculation showing how this works:

Stable enrollment: If your enrollment is stable, this will allow you to offer the same number of sections and reduce the total cost of the people teaching the course, because adjuncts, tutors, and undergraduate tutors are paid less than full-time faculty and because tutors and undergraduate tutors are paid less than adjuncts.

> *Traditional*: 800 students: 40 sections of 20 students each; 30 sections taught by full-time faculty; 10 sections taught by adjuncts.
> *Redesign*: 800 students: 40 sections of 20 students each; 10 sections taught by full-time faculty; 30 sections taught by adjuncts.

Growing enrollment: If your enrollment is growing, this will allow you to serve more students, offer more sections, and reduce the cost per student, because adjuncts, tutors, and undergraduate tutors are paid less than full-time faculty and because tutors and undergraduate tutors are paid less than adjuncts.

> *Traditional*: 800 students: 40 sections of 20 students each; 30 sections taught by full-time faculty; 10 sections taught by adjuncts.
> *Redesign*: 1,600 students: 80 sections of 20 students each; 20 sections taught by full-time faculty; 60 sections taught by adjuncts.

Jackson State Community College. In the traditional model, Jackson State offered 89 sections of developmental math with 20–24 students each during fall and spring, 63 of which were taught by full-time faculty (71 percent) and 26 by adjuncts (29 percent). The cost of tutors was $4,510, bringing the total cost of the traditional course to $333,159. In the redesigned model, Jackson State offered 71 sections during fall and spring; 44 sections enrolled 30 students each, and 27 enrolled 24 students each. The number taught by full-time faculty was 37 (52 percent), and the number taught by adjuncts was 34 (48 percent). The cost of tutors was $38,298, bringing the total cost of the redesigned course to $258,529. The cost per student of offering developmental math was reduced from $177 to $141, a 20 percent decrease. These changes enabled Jackson State to reallocate faculty time for other tasks within the mathematics department.

University of Alabama. The redesign of Intermediate Algebra at the University of Alabama generated cost savings by decreasing the number of faculty needed to teach the course while providing greater student interaction and consistency in learning outcomes. The university combined all sections into one and moved all structured learning activity to its Math Technology Learning Center, which was open 65 hours per week. Students also attended a 30-minute class session each week that focused on student problems and built community among students and instructors. The number of instructors needed to teach the course decreased from 10–12 to 6. A significant savings was realized through the use of undergraduate tutors to provide individualized student assistance in the lab in place of more-costly graduate students. The redesign reduced the cost per student from approximately $122 to $82, a 33 percent savings.

Q: What are some examples of doing both simultaneously?

A: Most redesigns employ both strategies simultaneously as the following examples illustrate.

Manchester Community College. The Manchester Community College team increased section size and changed the mix of personnel. Section size was doubled from 25 students in the traditional format to 50 students in the redesigned format. The number of sections offered was reduced from 60 to 31. The cost per student decreased from $255 to $165, a 35 percent savings. Instructors were able to double the number of students because there was significant reduction in faculty time required to grade homework and prepare assessment materials. In addition, instructors were assisted in each redesigned section by two or three tutors. This allowed ample time to provide the assistance needed for all students. There was almost never a time when students had to wait for help, and most instructors felt improved engagement with their students.

Lurleen B. Wallace Community College. At Lurleen B. Wallace Community College, the primary cost-saving technique was that each faculty member (full-time and adjunct) taught two developmental math redesigned sections of 29 students each for one workload credit rather

than one section of 24 students as they did in the traditional format. The availability of tutors and instructors in each class made it possible to increase section size and still provide individualized attention and assistance for all students. In addition, the number of faculty hours spent on developmental math was reduced by eliminating duplication of faculty responsibilities. The cost per student decreased from $114 in the traditional format to $53 in the redesign, a 54 percent savings. Faculty time was reallocated for other tasks within the mathematics department.

Q: Can the Emporium Model offer us a cost-effective way to offer low-enrollment sections?

A: A good strategy for dealing with low-enrollment sections made possible by the Emporium Model was conceived at Cleveland State Community College (CSCC) during the college's redesign of developmental math and has been implemented in many institutions since then. We (CSCC and NCAT) call the strategy the *one-room schoolhouse*, which produces both institutional cost savings and clear benefits to students.

When small sections do not fill (particularly at smaller campuses and sites or during certain class times), they have to be either canceled (interrupting student progression through the sequence and incurring lost revenue to the college) or offered at a relatively high cost. Using the one-room schoolhouse means that a college offers multiple developmental math courses in the same computer classroom or lab at the same time. Students work with instructional software, and instructors provide help when needed. Even though students are at different points in the developmental sequence, they can be in the same classroom. This strategy enables the institution to increase course offerings and avoid canceling classes, which in turn reduces scheduling roadblocks for students, enabling them to complete their degree requirements sooner. Because fewer sections are needed to accommodate the same number of students, overall cost per student can also be lowered.

Would the one-room schoolhouse strategy help solve scheduling problems on your campus and enable all students to take the courses they need to complete their programs on time?

In addition to Cleveland State Community College, the following institutions are among those that have implemented the one-room schoolhouse: Cochise College, Cossatot Community College of the University of Arkansas, Lurleen B. Wallace Community College, Northwest-Shoals Community College, Pearl River Community College, and Robeson Community College. To learn more about the specifics of implementation of this approach, follow the links at http://www.theNCAT.org/Mathematics/CTE/CTEInstitutions%20(rev).html for contact information.

Q: Are there further opportunities for cost savings beyond these three strategies in using the Emporium Model?

A: After several terms of full implementation of your redesign strategy, you may achieve further savings through such things as improved retention (increased course completion rates), the impact of modularization, and/or reduced space requirements. There are, however, a number of variables that may influence whether or not you are able to realize those additional savings, such as the number of students who accelerate versus the number who move at a slower pace and scheduling complexities. Because it is difficult to predict how these various elements will play out until you have some experience with the redesign over time, your plan for cost reduction should include one of the strategies listed previously, which will result in immediate savings during the first term of full implementation.

