The National Center for Academic Transformation

HOW TO REDESIGN A COLLEGE COURSE USING NCAT'S METHODOLOGY

IIIA. Six Models for Course Redesign: Those Most Frequently Used

Although all successful course redesigns at NCAT's partner institutions embody the Essential Elements of Course Redesign discussed in Chapter I, each has chosen a redesign model that implements the elements in ways that vary according to the discipline involved, the particular student audience, and faculty preferences.

In conducting redesign programs, NCAT's approach has been first to establish a set of broad parameters (e.g., redesign the whole course, use instructional technology, reduce cost) and then to let experimentation bloom within them. From that iterative process, a number of redesign solutions have emerged—some anticipated, some not.

After examining the similarities and differences in how those common elements are arrayed in the various redesigns, NCAT has identified six distinct course-redesign models: supplemental, replacement, emporium, fully online, buffet, and linked workshop. A key differentiator among them is where each model lies on the continuum: from fully face-to-face to fully online interactions with students.

The models are not intended to constrain those beginning a course redesign, nor are they the only possible options for improving learning while reducing costs. In the initial stages of trying to improve courses, redesign teams face a multitude of different ideas about things they might do. Beginning the redesign process by identifying the model that seems right for their redesign ideas helps them rapidly move from being presented with a seemingly overwhelming menu of choices to focusing on a few that are best matched to their goals for the course.

In this chapter we discuss the first three of the six models: supplemental, replacement, and emporium. Slightly more than 90 percent of NCAT redesigns have used one of these three models. Following are summaries of the characteristics of the first three course redesign models that have emerged from NCAT's course redesign programs.

The Supplemental Model. The supplemental model retains the basic structure of the traditional course. It either supplements lectures and textbooks with technology-based, out-of-class activities or also changes what goes on in class by creating an active learning environment within a large-lecture-hall setting.

The Replacement Model. The replacement model reduces the number of in-class meetings and either replaces some in-class time with out-of-class, online, interactive learning activities or also makes significant changes in the remaining in-class meetings. Although in some ways this model resembles what is often referred to as a *blended* or *hybrid* model, the key differentiator is that the replacement model *replaces* in-class time with technology-based activities rather than simply *adding* technology-based activities to the traditional course.

The Emporium Model. The emporium model replaces lectures with a learning resource center model featuring interactive computer software and on-demand personalized assistance.

Full descriptions of the three models with examples of each follow. Each example includes links to full case studies of the redesigns.

The Supplemental Model

- Retains the basic structure of the traditional course, particularly the number of class meetings.
- May simply supplement lectures and textbooks with technology-based, out-of-class activities to encourage greater student engagement with course content and to ensure that students are prepared when they come to class.
- More frequently also changes what goes on in class by creating an active learning environment within a large lecture setting.

Example That Adds Out-of-Class Activities and Does Not Change In-Class Activities

Carnegie Mellon University redesigned the laboratory portion of its introductory statistics course while leaving the lecture portion intact. The redesign used StatTutor, an automated, intelligent tutoring system that monitors students' work as they go through lab exercises. StatTutor provides students with feedback when they pursue an unproductive path, and it closely tracks and assesses individual students' acquisition of skills in statistical inference—in effect, providing a personal tutor for each student. After using StatTutor, students increased their scores on a test of skills and concepts by 3.65 out of 16 items, for a 22.8 percent increase—a significant improvement: $t(19)=5.877$, $p < .001$. In addition, StatTutor helped students achieve a level of statistical literacy not deemed possible in the course before its redesign. Carnegie Mellon reduced course costs from $195 to $171 per student, a decrease of 12 percent.

Examples That Add Out-of-Class Activities and Change In-Class Activities

To increase consistency and increase student engagement, the redesign of General Chemistry at the University of Arizona combined the lecture and the laboratory into one course and integrated discussion sections with laboratory work. Learner-centered modules were created to involve students in collaborative group work during lecture, laboratory, and discussion sessions. Laboratory activities were modified to create more opportunities for students to pose their own research questions, design experiments to solve problems, and reflect on the validity of their claims based on the experimental evidence they collected. The smaller discussion sections provide more-individualized attention and support for students, and they open avenues for active, inquiry-based learning. Graduate teaching assistants and undergraduate learning preceptors ran the discussion sections. Based on standardized American Chemical Society final exams, students in the redesign performed significantly better ($p < .05$) than their counterparts in previous years. The average final exam grade in the first two semesters of the course's offering was 59.3 plus or minus 15.1 percent compared with an average of 54.0 plus or minus 16.3 percent in the two previous years. The cost per student was reduced by 13 percent, generating a savings of about $100,000 per year.

The goal of the redesign of Introductory Biology at the University of Massachusetts Amherst was to create an active learning environment within a large-lecture-hall setting supplemented by a variety of out-of-class activities that ensured students were prepared when they came to class. Before class, students reviewed learning objectives, key concepts, and supplemental materials posted on the class website. As an assessment of their preparation for class, students then completed online quizzes, which provided immediate feedback for students and provided data for instructors to assess students' knowledge levels. Instructors became able to reduce

class time spent on topics that students clearly understood, increase time spent on problem areas, and target individual students for remedial help. Class time was divided into 10- to 15-minute lecture segments followed by sessions in which students worked in small groups applying concepts to solve problems posed by the instructor. Group responses were reported through a student-response system. The instructor moderated the discussions and drew out key issues to reinforce specific ideas or reveal misconceptions. At UMass, attendance in the traditional format averaged 67 percent; in the redesigned course, attendance averaged 90 percent, which correlated significantly with performance on exams. In the traditional course, exam scores averaged 61 percent; in the redesigned course, exam scores averaged 73 percent, a significant increase. In addition, exams no longer emphasize recall of factual material or definitions of terms; 67 percent of the questions now require reasoning or problem-solving skills, compared with 21 percent previously. The cost per student was reduced from $199 to $124, a savings of 38 percent.

At Northern Arizona University, the goal of the redesign of Introduction to Psychology was greater student engagement. The traditional format consisted of large lecture sections and two to four multiple-choice exams. The redesign incorporated a student-response system to make the large lecture periods more engaging. The in-class student response system provided real-time feedback about students' understanding and identified gaps that needed to be closed. Team teaching enhanced course quality by giving students the opportunity to learn from faculty with the greatest expertise in a given topic area. Four required out-of-class Web activities, each related to a specific topic in psychology; and 14 practice quizzes complemented course lectures and further engaged students with course material, which had previously been limited primarily to reading the textbook. Students received automated feedback to gauge their own progress and achievements. They were permitted to retake the quizzes, prior to a deadline, with the highest grade counting toward the course grade. An early-intervention system targeted students who were struggling as indicated by attendance taken by the response system, in-class responses, Web activities, and online practice quizzes. A pretest/posttest comparison of psychology knowledge revealed that performance improved by .72 of one standard deviation, the second best ever obtained for a face-to-face section since the department started using the knowledge assessment in 2005. The cost per student was reduced from $62 to $42, a 30 percent decrease.

The supplemental model has been used predominantly in social science and natural science courses. See http://www.theNCAT.org/PCR/model_supp_all.htm for case studies of course redesigns that used the supplemental model.

The Replacement Model

- Reduces the number of in-class meetings but does not eliminate all in-class meetings.
- Replaces rather than supplements some in-class time with online, interactive learning activities.
- Gives careful consideration to why and how often classes need to meet face-to-face.
- Assumes that certain activities can be better accomplished online—either individually or in small groups—than in a face-to-face class.
- May keep the remaining in-class activities more or less the same.
- May make significant changes in the remaining in-class meetings.
- May schedule out-of-class activities in round-the-clock computer labs or totally online so that students can participate anytime, anywhere.

Examples That Substitute Out-of-Class Activities for Some In-Class Time and Do Not Change In-Class Activities

The redesign of Introductory Statistics at Pennsylvania State University involved reducing lectures from three to one per week and changing two traditional recitation sections to two computer-studio labs. In the computer-studio labs, students worked individually and collaboratively on prepared activities. Approximately 30 percent of the lab time was used for elaboration of concepts, 60 percent for computer-related work and class discussion of the results, and 10 percent for online quizzes on concepts related to the activities. Students were tested regularly on assigned readings and homework via Readiness Assessment Tests (RATs), which were short quizzes that probed students' conceptual understanding. Constituting 30 percent of students' grades, RATs were given five to seven times during the course. Students prepared themselves to take the RATs outside class by reading the textbook, completing homework assignments, and using Web-based resources. Students then took the tests individually. Immediately following their individual efforts, students took the same test in groups of four. In addition to motivating students to keep on top of the course material, RATs have proved very effective in detecting areas in which students were not grasping the concepts, which enabled faculty to take corrective actions in a timely manner. Students in the redesigned course outperformed traditional-course students at a statistically significant level on a content-knowledge test: 60 percent correct in the traditional format, and 68 percent in the redesigned format. In addition, students in the redesigned course demonstrated greater understanding of a number of crucial statistical concepts. Penn State reduced the cost per student from $123 to $98, a 44 percent savings.

At the University of Maryland Eastern Shore (UMES), the redesign of Principles of Chemistry replaced three traditional 50-minute lectures per week with one 75-minute lecture per week and two required hours in a chemistry computer lab where students worked with a chemistry tutorial software package. Coordinated with the textbook, the software monitored student time spent working with the software and student progress; assigned and graded homework; randomly generated and graded quizzes; and assigned, graded, and compared pre- and postmodule assessments. Undergraduate learning assistants and tutors offered on-demand, personalized assistance in the lab. Students could also attend an optional recitation session once a week to review the concepts covered in that week's learning module. The recitation sessions were mandatory for students scoring less than 75 percent on quizzes and/or exams. The changes in the structure of the course were validated when the UMES team compared students' final grades by using the same grading criteria. In the traditional format, 54.5 percent of students earned grades of C or better. The percentage rose to 66 percent in the redesigned course. The cost per student decreased from $268 to $80, a 70 percent reduction.

Examples That Substitute Out-of-Class Activities for Some In-Class Time and Change In-Class Activities

The redesigns of introductory Spanish at the University of Tennessee, Knoxville (UTK), and at Portland State University (PSU) exemplify the second type of replacement model, in which some classes are replaced with online activities and the remaining classes are changed. The most significant academic problem in traditional Spanish courses is that about 85 percent of in-class time is spent explaining and practicing grammar and vocabulary instead of practicing the expressive skills of speaking and writing. Both UTK and PSU reduced class-meeting times from three to two per week and moved to an online environment those course aspects that could be better accomplished using technology. UTK online activities included grammar, vocabulary, and listening exercises; PSU's included testing, writing, and grammar instruction as well as small-

group activities focused on oral communication. Students received immediate feedback and detailed explanations in response to their online work, and class time was freed for interactive and collaborative learning experiences. Online grading has given instructors more time to prepare their classes and to focus on meaningful communicative and collaborative tasks in class. By making those changes, both universities have been able to increase the time that students spend in oral communication. Furthermore, they have been able to increase the number of students who can be served with the same personnel resources.

Tallahassee Community College (TCC) redesigned its entire college composition course by moving many of the instructional activities online while using in-class time to focus on activities that require face-to-face interaction. Like most other colleges, TCC traditionally taught writing in small sections of approximately 30 students each. Considerable class time was spent reviewing and re-teaching basic skills, thus reducing the amount of time during which students could engage in the writing process. TCC's redesign—which shifted to technology many of the basic instructional activities that can be readily individualized—enabled students and faculty to focus on the writing process in the classroom. TCC used technology to provide various resources: diagnostic assessments resulting in individualized learning plans; interactive tutorials in grammar, mechanics, reading comprehension, and basic research skills; online tutorials for feedback on written assignments; follow-up assessments; and discussion boards to facilitate the development of learning communities. Those resources were accessible to students at any time. Students also met in computerized classrooms with flexible configurations three times per week. However, since so many online activities were individualized and accessible out of class, class time on all three days could be used for students to work individually or in small groups on a wide range of writing activities that fostered collaboration, proficiency, and higher levels of thinking. TCC students in the redesigned course scored significantly higher ($p = 0.04$) on final essays, with an average score of 8.34 compared with 7.33 for students in the traditional course. The redesign resulted in a planned reduction in the cost per student from $252 to $145, a savings of 43 percent.

The replacement model can be implemented in any discipline. See http://www.theNCAT.org/PCR/model_replace_all.htm for case studies of course redesigns using the replacement model.

The Emporium Model

- Eliminates all lectures and replaces them with a learning resource center model featuring interactive software and on-demand personalized assistance.
- Depends heavily on instructional software, including interactive tutorials, practice exercises, solutions to frequently asked questions, and online quizzes and tests.
- Uses a staffing model that combines faculty, graduate teaching assistants, peer tutors, and others who respond directly to students' specific needs and direct students to resources from which they can learn.
- May require a significant commitment of space and equipment.
- Enables more than one course to be taught in an emporium, thus leveraging the initial investment.

NCAT's partner institutions have found that three versions of the emporium model have been successful: a flexible version, a fixed version, and a combination of a fixed version and a flexible version. In all versions, mandatory attendance (e.g., a minimum of three hours weekly) in a

computer lab or computer classroom ensures that students spend sufficient time on task and receive on-demand assistance when they need it.

Examples of Flexible Attendance

A minimum number of lab hours are mandatory, but they may be completed at any time at the student's convenience. In addition, mandatory weekly group meetings outside a computer lab enable instructors to follow up when testing has identified weaknesses, make connections among concepts, emphasize particular applications, and build community among students and with instructors.

- Louisiana State University: College Algebra
- The University of Alabama: Intermediate Algebra

Examples of Fixed Attendance

Mandatory laboratory hours are scheduled by the institution. Students are divided into course sections and meet at fixed (scheduled) times—in the laboratory or in a computer classroom with an instructor—equivalent to meeting times in the traditional format: two to four times a week.

- Jackson State Community College: Basic Math, Elementary Algebra, and Intermediate Algebra
- Nashville State Community College: Basic Math, Elementary Algebra, and Intermediate Algebra

Examples of Fixed/Flexible Attendance

Cleveland State Community College developed the third version, which is a combination of fixed and flexible hours. In this version, three to five mandatory hours are required each week, but represent a combination of one fixed classroom meeting, flexible hours in the lab, and additional hour(s) spent working with the software from anywhere (e.g., from home.)

- Leeward Community College: Basic Math through Problem Solving, Introductory Algebra with Geometry, and Algebraic Foundations I and II
- Northern Virginia Community College: Arithmetic, Algebra I, and Algebra II

NCAT has published the following two guides, which describe in great detail how to successfully complete a course redesign in mathematics by using the emporium model.

- How to Redesign a College-Level or Developmental Math Course Using the Emporium Model
  This guide focuses on redesigning all sections of a *single* math course at both the developmental and college levels.
- How to Redesign a Developmental Math Program Using the Emporium Model
  This guide focuses on redesigning the entire developmental math *sequence* rather than a single course.

Although there is substantial overlap between the two guides, there are also substantial differences.

Example of Using the Emporium Model in Other Disciplines

The emporium model has most commonly been implemented in mathematics, but it can also be implemented in other disciplines. Northeast State Technical Community College, for example, used the emporium model to redesign Developmental Reading. The traditional reading course had been a three-credit-hour, lecture-based course taught annually in 24 small sections of about 17 students each; 12 sections were taught by full-time faculty, and 12 by adjuncts. In the redesigned course, one large section of all students replaced the multiple, small sections. Instead of meeting as a class, students were required to spend two hours in a reading center lab working with a high-quality, interactive, modularized-learning software package. The software produced individualized study plans by using a diagnostic assessment. Thus, each student focused on what he or she needed to master rather than studying all topics equally. Instructors and tutors were available in the lab to provide personalized assistance for students when needed. Students and the instructor also met once weekly as a reading group. In addition to working required hours in the lab weekly, students could access the learning software on the Web at other times or could come to the lab to spend additional time with assistance. Analysis of pretest and posttest Nelson-Denny scores revealed that students in the redesigned course achieved greater gain in their learning and reading skills. In the traditional course, the average gain was 11 points; in the redesigned course, the average gain was 21 points. The total cost of offering the traditional course had been $80,832. The total cost of the redesigned course was $39,639, a 51 percent reduction.

