

## REDESIGNING DEVELOPMENTAL AND COLLEGE-LEVEL MATH SIX PRINCIPLES OF SUCCESSFUL COURSE REDESIGN

From working with large numbers of students, faculty and institutions over the past 10 years, NCAT has learned what works and what does not work in improving student achievement in both developmental and college-level mathematics. We have identified six principles that lead to successful course redesign. Each of these principles has both a quality dimension that contributes to improved student learning and a cost dimension that contributes to reduced instructional costs. The following principles are essential to achieving success in mathematics course redesign.

### **Principle #1: Redesign the whole course.**

In the Emporium Model, the whole course--rather than a single class or section--is the target of redesign. The course is treated as a set of products and services that can be continuously worked on and improved by all faculty members rather than as a "one-off" that gets re-invented by individual faculty members each term. The collective commitment of all faculty members teaching the course coupled with the capabilities provided by information technology leads to success. Information technology enables best practices to be captured in the form of interactive web-based materials supported by sophisticated course-management software. Faculty can systematically incorporate feedback from all involved in the teaching and learning process, adding to, replacing, correcting and improving an ever-growing body of learning materials and best practices.

#### Improving Quality

Any large developmental or introductory course taught by multiple instructors faces the problem of "course drift," especially when there are large numbers of adjunct faculty members involved in teaching the course. The phrase "course drift" refers to what happens when individual instructors teach the course to suit their individual interests rather than to meet agreed-upon learning goals for students, resulting in inconsistent learning experiences for students and inconsistent learning outcomes. Redesign that ensures consistent content coverage means that all students have the same kinds of learning experiences, resulting in significant improvements in course coherence and quality control.

#### Reducing Cost

Redesigning the whole course eliminates duplication of effort on the part of instructors and creates opportunities for using alternate staffing patterns. Faculty begin the design process by analyzing the amount of time that each person involved in the course spends on each kind of activity, which often reveals duplication of effort among multiple faculty members. Faculty members teaching the course divide their tasks among themselves and target their efforts to particular aspects of course delivery. By replacing individual development of each course section with shared responsibility for both course development and course delivery, faculty can save substantial amounts of their time while achieving greater course consistency.

## Example

The course redesign involved the whole course—that is, all sections are now taught using the Emporium Model. Three courses were reorganized into one course broken down into 12 modules. Historically, all instructors who taught the course used a common list of course objectives, but each faculty member developed his or her own course materials, activities, homework assignments, handouts and tests. The only common element was the final exam, which was written each semester by a committee. The redesign eliminated duplication of effort as the course became standardized with a common syllabus and common teaching materials, assignments and tests. A team of faculty was responsible for course development and course delivery strategies, saving time and achieving more course consistency. The team also determined appropriate assessments for placing students in needed modules as well as learning assessments for each module. Training and ongoing monitoring of all instructors (full-time faculty and adjuncts) and tutors (retired high school mathematics teachers and peer tutors) ensured consistent student learning experiences and outcomes.

## **Principle #2: Encourage active learning.**

The Emporium Model makes significant shifts in the teaching-learning enterprise, making it more active and learner-centered. Lectures and other face-to-face classroom presentations are replaced with an array of interactive materials and activities that move students from a passive, note-taking role to an active-learning orientation. As one math professor puts it, "Students learn math by doing math, not by listening to someone talk about doing math." Instructional software and other web-based learning resources assume an important role in engaging students with course content. Resources include tutorials, exercises and low-stakes quizzes that provide frequent practice, feedback and reinforcement of course concepts. In moving from an entirely lecture-based to a student-engagement approach, learning is less dependent on words uttered by instructors and more dependent on problem-solving undertaken actively by students.

## Improving Quality

Encouraging active learning is a well-accepted pedagogical principle that leads to improved student learning. As Arthur W. Chickering and Zelda F. Gamson note in their 1987 *Seven Principles for Good Practice in Undergraduate Education*, "Learning is not a spectator sport. Students do not learn much just sitting in classes listening to teachers, memorizing prepackaged assignments, and spitting out answers. They must talk about what they are learning, write reflectively about it, relate it to past experiences, and apply it to their daily lives. They must make what they learn part of themselves. Working with others often increases involvement in learning. Sharing one's own ideas and responding to others' reactions sharpens thinking and deepens understanding."

## Reducing Cost

When redesigns reduce the number of lectures or other classroom presentations that faculty members must prepare for and present and replace those formats with interactive learning resources and team-based learning strategies, faculty time can be reallocated to other tasks, either within the same course or in other courses. Moving away from viewing instructors as the sole source of content knowledge and assistance to a greater

reliance on interactive learning materials and greater student/student interaction offers many opportunities for reducing instructional costs.

### Example

The course redesign obligated students to become actively engaged in learning the course material. The role of the faculty moved from one of dispenser of knowledge to one of partner or helper in the learning process. Each student was required to spend a minimum of three hours each week in the lab using interactive software for instruction and practice, with support from faculty and undergraduate learning assistants. Students were also expected to engage in these activities outside the structured lab setting if needed. Modularized online tutorials presented course content with links to a variety of additional learning tools: videos, lecture notes and exercises. Instructional software supported auditory, visual, and discovery-based learning styles by including interactive tutorials, computational exercises, practice exercises, solutions to frequently asked questions and online quizzes. Navigation was interactive; students could choose to see additional explanation and examples along the way. Online weekly practice quizzes replaced weekly homework grading; all grading and record-keeping was automated.

### **Principle #3: Provide students with individualized assistance.**

In traditional lecture or classroom formats, students are often unlikely or unable to ask questions. Office hours attempt to mitigate this problem, but students notoriously do not take advantage of them. Students need help when they are "stuck" rather than during fixed times or by appointment. The Emporium Model replaces lecture time with individual and small-group activities that take place in computer labs—staffed by instructors, professional tutors and/or peer tutors—and/or online, enabling students to have more one-on-one assistance. Students cannot live by software alone, however. When students get stuck, the tutorials built into most software programs are not enough to get them moving again. Students need human contact as well as encouragement and praise to assure them that they are on the right learning path. An expanded support system enables students to receive help from a variety of different people. Helping students feel that they are a part of a learning community is critical to persistence, learning, and satisfaction.

### Improving Quality

Offering students help when they need it rather than according to a schedule not only addresses the particular problems they encounter but also helps keep them on task. Students who are unable to receive help at the time they need it too often give up and do not complete the task that they have been assigned. In addition to providing individualized assistance to students, faculty and others responsible for the course can learn what areas are most difficult for students and can continuously improve the learning activities included in the course.

### Reducing Cost

By constructing support systems of various kinds of instructional personnel, the projects apply the right level of human intervention to particular student problems. Highly trained, expert faculty members are not required for all tasks associated with a course. By replacing expensive labor (full-time faculty members and graduate teaching assistants)

with relatively inexpensive labor, less expert (adjunct faculty members, undergraduate peer mentors and course assistants) where appropriate, it is possible to increase the person-hours devoted to the course and the amount of assistance provided to students.

### Example

The traditional model increased the likelihood that students got discouraged and stopped doing the work for two reasons: 1) they had to do most of their work without immediate support, and 2) they had to admit in front of fellow students what they did not understand. Since most students would rather remain invisible than interact with the instructor in a public way in order to protect themselves from embarrassment, they often did not resolve the questions they had.

The redesign provided students with more individualized assistance in a variety of ways: 1) Students received individualized help from the tutorials, practice problems and guided solutions that are built into the software. When a student got stuck, he or she could ask for an example or a step-by-step explanation. Instant feedback let students review their errors at the time they made them. 2) Students received face-to-face, one-on-one help in the learning center. Instructors, professional tutors and/or peer tutors were available to provide individual assistance if students encountered difficult concepts while working on problems. A tutor or instructor could look at the student's work and determine if he or she was making errors due to carelessness, lack of understanding of concepts or misuse of the computer software. 3) Students received additional support and encouragement in the weekly meeting with their instructor. Faculty spent more time answering questions and helping students and less time grading papers and sitting idly in their offices. 4) Students also got help from fellow students. In the learning center, computer stations were arranged in pods of four to six to encourage student collaboration.

### **Principle #4: Build in ongoing assessment and prompt (automated) feedback.**

Increasing the amount and frequency of feedback to students is a well-documented pedagogical technique that leads to increased learning. Rather than relying on individual faculty members in small sections to provide feedback for students (a technique known to increase faculty workload significantly), the Emporium Model utilizes computer-based assessment strategies. A large bank of problems for each course topic is built into instructional software, and assignments are graded on the spot. Students can work as long as needed on any particular topic, moving quickly or slowly through the material depending on their comprehension and past experience or education. By automating the feedback process, every problem or question is graded, and students receive specific information about their performance. This, in turn, leads to more efficient and focused time on task and higher levels of learning. Building in ongoing assessment and automated feedback also lets faculty know how well students are (or are not) doing and take timely corrective action.

### Improving Quality

Shifting the traditional assessment approach from midterm and final examinations toward continuous assessment is an essential pedagogical strategy. Students can be regularly tested on assigned readings and homework using short quizzes that probe their preparedness and conceptual understanding. These low-stakes quizzes motivate

students to keep on top of the course material, structure how they study and encourage them to spend more time on task. Online quizzing encourages a "do it till you get it right" approach: Students can be allowed to take quizzes as many times as they want to until they master the material. Students need detailed diagnostic feedback that points out why an incorrect response is inappropriate and directs them to material that needs review. Automating assessment and feedback enables repeated practice as well as providing prompt and frequent feedback--pedagogical techniques that research has consistently proven to enhance learning.

### Reducing Cost

The idea of giving students prompt feedback is a well-known pedagogical technique that leads to improved learning. Pedagogy in itself has nothing to do with technology. What is significant about using technology is that doing so allows faculty to incorporate good pedagogical practice into courses with very large numbers of students—a task that would have been impossible without technology. When instructors are solely responsible for grading, typically they must make compromises such as spot-grading or returning composite scores to students. By replacing hand-grading with automated grading of homework, quizzes and exams, it is possible to reduce the cost of providing feedback while improving its quality. In addition, by assessing and aggregating what students do and do not understand, both individually and collectively, faculty are able to spend class time on what students do not know rather than wasting time on what they already understand, a great improvement over the one-size-fits-all lecture method.

### Example

In the traditional model, students typically turned in homework problems that were hand-graded and returned days after the students did the problems and made mistakes. By the time students saw the graded homework, they were not sufficiently motivated to review their errors and correct the problem.

In the redesign, instructional software provided immediate "intelligent" feedback to students in several ways: 1) Students were assigned homework practice sets every week. The software identified errors and offered step-by-step guidance on solving questions when students had difficulty. Student could select "Show Me How" on the tutorial or simply "Work a Similar Exercise." 2) Used as practice tests, weekly quizzes provided a more test-like environment for assessing competence, and feedback was immediate. The quiz component of the software required students to complete the entire set of exercises before learning which problems were correct or incorrect. This took students to the next learning level of not depending on step-by-step assistance. 3) Hourly exams were also administered on the computer and graded immediately by the software upon submission. 4) Because learning mathematics is not just getting the answer correct, students were also required to keep a notebook demonstrating their work on their homework and practice tests. This work was graded holistically using common rubrics.

### **Principle #5: Ensure sufficient time on task and monitor student progress.**

The Emporium Model adds greater flexibility in the times and places of student engagement with the course. This does not mean, however, that the redesign projects are "self-paced." Rather than depending on class meetings, the redesigns ensure

student pacing and progress by requiring students to master specific learning objectives, frequently in modular format, according to scheduled milestones for completion. Although some projects initially thought of their designs as self-paced, open-entry/open-exit, they quickly discovered that students need structure (especially first-year students and especially in disciplines that may be required rather than chosen) and that most students simply will not make it in a totally self-paced environment. Students need a concrete learning plan with specific mastery components and milestones of achievement, especially in more flexible learning environments.

Most software packages have excellent tracking features, allowing faculty to monitor students' time on task. All projects have seen a strong, direct correlation between student success and time on task. A frequently encountered problem was getting students to spend enough time on task working with the software. Some students were slow to log in, getting too far behind to catch up. Worse yet, some students never logged on. Most projects found it necessary to require students to log in at specific intervals and to spend a minimum amount of time working with course materials. Others established some form of early alert intervention system-- a kind of "class management by exception" process, whereby baseline performance standards were set and those who were falling too behind were contacted. Email can be used to post messages and communicate with students to encourage them to "come to class."

### Improving Quality

As Arthur W. Chickering and Zelda F. Gamson note in their 1987 *Seven Principles for Good Practice in Undergraduate Education*, "Time plus energy equals learning. There is no substitute for time on task. Learning to use one's time well is critical for students and professionals alike. Students need help in learning effective time management. Allocating realistic amounts of time means effective learning for students and effective teaching for faculty." Even though we know that time on task is essential to effective learning, it is difficult for faculty members in traditional formats unaided by technology to ascertain how much time on task each student is actually spending and to take corrective action.

### Reducing Cost

By replacing time-consuming human monitoring of student performance with course management software, it is possible to reduce costs while increasing the level and frequency of oversight of student progress. Sophisticated course-management software packages enable faculty members to monitor student progress and performance, track their time on task, and intervene on an individualized basis when necessary. Course management systems can automatically generate many different kinds of tailored messages that provide needed information to students. They can also communicate automatically with students to suggest additional activities based on homework and quiz performance, or to encourage greater participation in online discussions. Using course-management systems radically reduces the amount of time that faculty members typically spend in non-academic tasks like calculating and recording grades, photocopying course materials, posting changes in schedules and course syllabi, sending out special announcements to students—as well as documenting course materials like syllabi, assignments, and examinations so that they can be used in multiple terms.

## Example

In the traditional model, students spent a lot of time watching or listening to a lecture given by someone else. The three hours that students spent listening to lectures were three hours that could have been spent doing math. As one community college redesign team 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.”

The redesign included three hours of mandatory lab attendance each week. By using an instructional software package, students were able to spend more time on task. Students in the redesigned courses simply did more work than before and worked harder than ever in order to be successful. Students also spent additional time in the computer lab or at home. The mandatory computer lab helped to ensure that students spent sufficient time-on task in order to master the material. In order to pass each course, students were required to achieve a mastery level of at least 80% on each homework assignment and pass every quiz and exam before moving ahead to the next unit, a learning approach that guaranteed that students would be successful as they moved forward. The redesign also required students to attend one group session each week, which focused on students' problems and allowed instructors to follow up in areas where testing defined weaknesses. The group activities helped build community among students and between students and instructors.

The instructional software package used in the course has an excellent tracking feature which allowed instructors to monitor the time each student spent using the software each week, weekly lab attendance, completion of assignments and performance on quizzes and exams. Record-keeping was made easy using the online grade book. Instructors could email students to encourage students or suggest additional activities. Students whose progress was not satisfactory were contacted in person by their instructors in a timely manner so that corrective actions could be taken. Students who were exceeding expectations were sent encouraging messages as well.

### **Principle #6: Modularize the student learning experience, especially in developmental math.**

The traditional lecture format treats students as “one size fits all.” Some students are bored because other students’ questions result in repetition of conceptual material they have already mastered, while other students feel overwhelmed by the amount of material covered in one lecture session. In contrast, modularizing the curriculum customizes the learning environment for each student based on background, skill level, learning preference and academic/professional goals. The development of better placement systems combined with shorter remedial/developmental modules enables students to save time and money by only enrolling in the modules that address their deficiencies. When students understand the material, they can move quickly through it and demonstrate mastery. When students get stuck, they can take more time to practice, receive individualized assistance and demonstrate mastery.

Modularization does not mean merely dividing the course content into modules—after all, that’s like chapters in a textbook—and continuing to meet in small groups in traditional classroom settings with “teacher-led” activities. Modularization means individualizing the student experience. There is a contradiction between individualizing the student

experience (i.e., diagnosing individual students' strengths and weaknesses and creating individual paths for them to correct their deficiencies) and meeting in traditional classes in which students are grouped together primarily for scheduling reasons. Student progress through the course materials varies considerably. One-third may be in the middle of the material in any given class, one-third may have already accomplished the goals of today's class, and one-third may be lagging behind. Some students may be bored because other students' questions result in repetition of conceptual material they have already mastered, while other students feel overwhelmed by the amount of material covered in one class. It's not that meeting in groups is a bad thing to do. But a successful redesign needs to reconcile modularization and group meetings in new and innovative ways.

### Improving Quality

Modularization means creating a learning environment that allows students to focus on the skills that they are lacking, to study only topics in which they are unprepared, and to receive remediation assistance only in the areas where they have deficiencies. To do this, one must create diagnostic assessments that evaluate specific skills linked to content modules to ensure that students only take the modules in which they have skill deficiencies. One must also remove skills overlap that may be present among courses in the current structure to streamline the curriculum. Students should be able to start anywhere in the 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. Students should also be able to earn variable credit based on how many modules they successfully complete during a term.

### Reducing Cost

In the traditional format, the assumption is that all students need to study all remedial/developmental math course content at the same pace. In contrast, modularization assumes that each student is different, each student has different learning gaps, each student will move at a different pace--faster or slower-- through different parts of the curriculum. Once the remedial/developmental math course sequence is modularized and students are placed more explicitly and able to remedy their deficiencies, the number of required "offerings" will inevitably decrease. While it is difficult for institutions to plan for reduced offerings before gaining some experience with the impact of redesign, modularization will lead to a reduced need for course sections.

### Example

In the redesign, each course was reorganized to contain 10 – 12 modules. Students were expected to complete a module or more each week, completing homework over learning objectives and taking a short quiz covering the information. Students were able to work on the homework continuously with an eye towards completing it at or near a score of 100% correct. This was possible because the students could work on homework problems multiple times until they got the problem correct. Quizzes were also available multiple times, with the students re-testing until they displayed mastery over each module. Students had the option of completing more than one module each week—i.e., they could move through each course at an accelerated pace. Students who completed one developmental math course early could begin the next course

immediately. Registration in developmental math courses was flexible throughout the semester in order to maximize student success.

## **Conclusion**

One of the strongest reasons for using information technology in teaching and learning is that it can radically increase the array of learning possibilities presented to each individual student. Thus, the "right way" to design a high-quality course depends entirely on the type of students involved. Students need to be treated like individuals, rather than homogenous groups, and should be offered many more learning options within each course. By customizing the learning environment for each student, institutions are likely to achieve greater learning successes.

Rather than maintaining a fixed view of what all students want or what all students need, institutions must be flexible and create environments that enable greater choice for students. Students differ in the backgrounds they bring to a course. While some students have strong prior experiences in particular concepts, either through good high school preparation or other work experience, other students have weaker backgrounds. Offering students greater choice so that they can identify and spend time on the areas where they lack knowledge rather than spending equal time on all areas can accommodate such variation in backgrounds. Students also differ in the amount of interaction that they require with faculty, staff, and one another.

Currently in higher education, both on campus and online, we individualize faculty practice (that is, we allow individual faculty members great latitude in course development and delivery) and standardize the student learning experience (that is, we treat all students in a course as if their learning needs, interests, and abilities were the same). Instead, we need to do just the opposite: individualize student learning and standardize faculty practice. By thinking more creatively about how to develop course designs that respond to a variety of learning styles and preferences, we can include structures and activities that work well with diverse types of students and lead to better, more cost-effective learning for all.

## **Four Models for Assessing Student Learning**

What follows is a summary of the most effective and efficient ways to assess student learning.

### Improved Learning

The basic assessment question to be answered is the degree to which improved learning has been achieved as a result of the course redesign. Answering this question requires comparisons between the student learning outcomes associated with a given course delivered in its traditional form and in its redesigned form.

#### I. Establish the method of obtaining data

##### A. Pilot Phase

This comparison can be accomplished in one of two ways:

##### 1. Parallel Sections (Traditional and Redesign)

Run parallel sections of the course in traditional and redesigned formats and look at whether there are any differences in outcomes—a classic "quasi-experiment."

##### 2. Baseline "Before" (Traditional) and "After" (Redesign)

Establish baseline information about student learning outcomes from an offering of the traditional format "before" the redesign begins and compare the outcomes achieved in a subsequent ("after") offering of the course in its redesigned format.

##### B. Full Implementation Phase

Since there will not be an opportunity to run parallel sections once the redesign reaches full implementation, use baseline data from a) an offering of the traditional format "before" the redesign began, or b) the parallel sections of the course offered in the traditional format during the pilot phase.

The key to validity in all cases is a) to use the same measures and procedures to collect data in both kinds of sections and, b) to ensure as fully as possible that any differences in the student populations taking each section are minimized (or at least documented so that they can be taken into account.)

#### II. Choose the measurement method

The degree to which students have actually mastered course content appropriately is, of course, the bottom line. Therefore, some kind of credible assessment of student learning is critical to the redesign project.

Four measures that may be used are described below.

#### A. Comparisons of Common Final Exams

Some projects use common final examinations to compare student learning outcomes across traditional and redesigned sections. This approach may include sub-scores or similar indicators of performance in particular content areas as well as simply an overall final score or grade. (Note: If a grade is used, there must be assurance that the basis on which it was awarded is the same under both conditions—e.g., not “curved” or otherwise adjusted.)

##### 1. Internal Examinations (Designed by Faculty)

*Parallel Sections Example:* “During the pilot phase, students will be randomly assigned to either the traditional course or the redesigned course. Student learning will be assessed mostly through examination developed by departmental faculty. Four objectively scored exams will be developed and used commonly in both the traditional and redesigned sections of the course. The exams will assess both knowledge of content and critical thinking skills to determine how well students meet the six general learning objectives of the course. Students will take one site-based final exam as well. Student performance on each learning outcome measure will be compared to determine whether students in the redesigned course are performing differently than students in the traditional course.”

*Before and After Example:* “The specifics of the assessment plan are sound, resting largely on direct comparisons of student exam performance on common instruments in traditional and re-designed sections Sociology faculty have developed a set of common, objective, questions that measure the understanding of key sociological concepts. This examination has been administered across all sections of the course for the past five years. Results obtained from the traditional offering of the course will be compared with those from the redesigned version.”

##### 2. External Examinations (Available from Outside Sources)

*Parallel Sections Example:* “The assessment plan involves random assignment of students to “experimental” (redesign) and “control” (traditional) groups operating in parallel during the pilot phase of implementation. Assessment will measure student success against established national (ACTFL) guidelines, including an Oral Proficiency Interview that has been widely validated and is also in use in K-12 settings. This will allow the university to compare results of the redesign to baseline literature about results of traditional pedagogy, to compare the added effect of use of multimedia to the same material delivered conventionally, and to gauge the effect of new remediation strategies on student performance.”

*Before and After Example:* “The centerpiece of the assessment plan with respect to direct measures of student learning is its proposed use of the ACS Blended Exam in Chemistry in a before/after design—administered to students in both traditional and redesigned course environments. A well-accepted instrument in chemistry, the ACS Exam has the substantial advantage of allowing inter-institutional comparisons according to common standards.”

## B. Comparisons of Common Content Items Selected from Exams

If a common exam cannot be given—or is deemed to be inappropriate—an equally good approach is to embed some common questions or items in the examinations or assignments administered in the redesigned and traditional delivery formats. This design allows common baselines to be established, but still leaves room for individual faculty members to structure the balance of these finals in their own ways where appropriate. For multiple-choice examinations, a minimum of twenty such questions should be included. For other kinds of questions, at least one common essay, or two or three problems should be included.

*Parallel Sections Example:* “The primary technique to be used in assessing content is common-item testing for comparing learning outcomes in the redesigned and traditional formats. Traditional and redesigned sections will use many of the same exam questions. Direct comparisons on learning outcomes are to be obtained on the basis of a subset of 30 test items embedded in all final examinations.”

*Before and After Example:* “The assessment plan must address the need to accommodate a total redesign in which running parallel sections is not contemplated. The plan calls for a “before/after” approach using 30 exam questions from the previously delivered traditionally-configured course and embedding them in exams in the redesigned course to provide some benchmarks for comparison.”

## C. Comparisons of Pre- and Post-tests

A third approach is to administer pre- and post-tests to assess student learning gains within the course in both the traditional and redesigned sections and to compare the results. By using this method, both post-test results and “value-added” can be compared across sections.

*Parallel Sections Example:* “The most important student outcome, substantive knowledge of American Government, will be measured in both redesigned and traditional courses. To assess learning and retention, students will take: a pre-test during the first week of the term and a post-test at the end of the term. The Political Science faculty, working with the evaluation team, will design and validate content-specific examinations that are common across traditional and redesigned courses. The instruments will cover a range of behaviors from recall of knowledge to higher-order thinking skills. The examinations will be content-validated through the curriculum design and course objectives.”

*Before and After Example:* “Student learning in the redesigned environment will be measured against learning in the traditional course through standard pre- and post-tests. The university has been collecting data from students taking Introduction to Statistics, using pre- and post-tests to assess student learning gains within the course. Because the same tests are administered in all semesters, they can be used to compare students in the redesigned course with students who have taken the course for a number of years, forming a baseline about learning outcomes in the traditional course. Thus, the institution can compare the learning gains of students in the newly redesigned learning environment with the baseline measures already collected from students taking the current version of the course.”

## D. Comparisons of Student Work Using Common Rubrics

Naturally occurring samples of student work (e.g. papers, lab assignments, problems, etc.) can be collected and their outcomes compared—a valid and useful approach if the assignments producing the work to be examined really are quite similar. Faculty must have agreed in advance on *how* student performance is to be judged and on the *standards* for scoring or grading (a clear set of criteria or rubrics to grade assignments.) Faculty members should practice applying these criteria in advance of the actual scoring process to familiarize themselves with it and to align their standards. Ideally, some form of assessment of inter-rater agreement should be undertaken.

*Parallel Sections Example:* “Students complete four in-class impromptu writing assignments. A standard set of topics will be established for the traditional and redesigned sections. A standardized method of evaluating the impromptu essays has already been established and will be used in grading each assignment. The essays are graded by using a six-point scale. The reliability measure for this grading scale has been established at 0.92. Additionally, each paper is read by at least two readers. The grading rubric will be applied to the four standard writing assignment prompts administered in parallel in simultaneously offered redesigned and traditional course sections.”

*Before and After Example:* “The assessment plan is quite sophisticated, involving both “before/after” comparisons of student mastery of statistics concepts in the traditional course and the redesigned course. The design itself involves direct comparisons of performance on common assignments and problem sets using detailed scoring guides (many of which were piloted and tested previously and are thus of proven utility). Because the department has already established and benchmarked learning outcomes for statistics concepts in considerable detail, and uses common exercises to operationalize these concepts, the basis of comparison is clear.”

### Tips

- Avoid creating “add-on” assessments to regular course assignments such as specially constructed pre and post-tests. These measures can raise significant problems of student motivation. It is easier to match and compare regular course assignments.
- If parallel sections are formed based on student choice, it would be a good idea to consider whether differences in the characteristics of students taking the course in the two formats might be responsible for differences in results. Final learning outcomes could be regressed on the following: status (full vs. part-time); high-school percentile rank; total SAT score; race; gender; whether or not the student was taught by a full-time or part-time faculty member; and whether or not the student was a beginning freshman.
- In addition to choosing one of the four required measures, the redesign team may want to conduct other comparisons between the traditional and redesigned formats such as:
  1. Performance in follow-on courses
  2. Attitude toward subject matter
  3. Deep vs. superficial learning
  4. Increases in the number of majors in the discipline
  5. Student interest in pursuing further coursework in the discipline

6. Differences in performance among student subpopulations
7. Student satisfaction measures

## **COST REDUCTION STRATEGIES**

Previous NCAT redesign projects in mathematics have used a variety of strategies to reduce instructional costs. Here is a summary of the strategies that have proven to be most effective.

Step 1. Identify the enrollment profile of the course

- Is the course enrollment stable?

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.

- Do you want to accommodate enrollment growth?

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 by teaching more students with the same staffing.

Step 2. Choose the labor savings tactic(s) that will allow you to implement the chosen strategy with no diminution in quality.

Traditional formats require instructors to carry out all of the development and delivery aspects of a course on their own. Course redesign involves substituting technology for much of that effort, often with the assistance of different kinds of personnel. Making the substitutions listed below allows each instructor to teach more students than before without increasing his or her workload.

- Substitute coordinated development and delivery of the whole course and shared instructional tasks for individual development and delivery of each individual course section.
- Substitute interactive tutorial software for face-to-face class meetings.
- Substitute automated grading of homework, quizzes, exams for hand grading.
- Substitute course management software for human monitoring of student performance and course administration.
- Substitute interaction with other personnel for one-to-one faculty/student interaction.

Step 3. Choose the appropriate cost reduction strategy.

There are three ways to re-structure the course that will reduce costs.

1. Each instructor carries more students. This can be done by
  - a. increasing section size, or
  - b. increasing the number of sections that 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 that fewer resources are devoted to the course. When enrollment is growing, cost reduction means that more students can be served on the same resource base. In each case, the cost-per-student (total resources devoted to the course/total course enrollment) is reduced.

### **1. Each instructor carries more students.**

#### a. Increase section size

*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.

##### Examples

*Traditional:* 800 students: 40 sections of 20 students each taught by 40 instructors.  
S/F ratio = 20:1

*Redesign:* 800 students: 20 sections of 40 students each taught by 20 instructors.  
S/F 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.

##### Examples

*Traditional:* 800 students: 40 sections of 20 students each taught by 40 instructors.  
S/F ratio = 20:1

*Redesign:* 1600 students: 40 sections of 40 students each taught by 40 instructors.  
S/F ratio = 40:1

#### b. Increase the number of sections that each instructor carries for the same workload credit.

*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.

##### Examples

*Traditional:* 800 students: 40 sections of 20 students each; each instructor teaches one section for the same workload credit. S/F ratio = 20:1

*Redesign:* 800 students: 40 sections of 20 students; each instructor teaches two sections for the same workload credit. S/F 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.

##### Examples

*Traditional:* 800 students: 40 sections of 20 students each; each instructor teaches one section for the same workload credit. S/F ratio = 20:1

*Redesign:* 1600 students: 80 sections of 20 students; each instructor teaches two sections for the same workload credit. S/F ratio = 40:1

## 2. Change the mix of personnel from more expensive to less expensive.

*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 since adjuncts, tutors and undergraduate tutors are paid less than full-time faculty, and tutors and undergraduate tutors are paid less than adjuncts.

### Examples

*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; 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 since adjuncts, tutors and undergraduate tutors are paid less than full-time faculty, and tutors and undergraduate tutors are paid less than adjuncts.

### Examples

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

*Redesign:* 1600 students: 80 sections of 20 students; 20 sections taught by full-time faculty; 60 sections taught by adjuncts.

## 3. Do both simultaneously.

Most redesigns employ both strategies simultaneously as the examples below illustrate.

### **Examples**

[Cleveland State Community College \(CSCC\)](#): 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%) and 10 by adjuncts (18%). 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 \$51,418, a 19% reduction. The FTE teaching load per faculty member went from 21.2 to 26.0 with no increase in workload. Faculty used to teach five sections per semester. In the redesign, faculty members taught 10-11 sections, which met once per week, and worked 8–10 hours in the lab. Increased faculty productivity enabled the department to eliminate the use of adjunct instructors while increasing course offerings. Overloads were also reduced as a result of the redesign project.

[Jackson State Community College \(JSCC\)](#): In the traditional model, Jackson State offered 89 sections of developmental math of 20–24 students each during fall and spring, 63 of which were taught by full-time faculty (71%) and 26 by adjuncts (29%). The cost of tutors was \$4,510, bringing the total cost of the traditional course to \$333,159. In the redesigned model, JSCC offered 71 sections during fall and spring; 44 sections

enrolled 30 students and 27 enrolled 24 students. The number taught by full-time faculty was 37 (52%), and the number taught by adjuncts was 34 (48%). 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% decrease. These changes enabled Jackson State to reallocate faculty time for other tasks within the mathematics department.

[Louisiana State University \(LSU\)](#): The redesign of College Algebra at LSU produced cost savings by serving the same number of students with one-half of the personnel used in the traditional model. Section size stayed at 40-44 students, but the number of class meetings each week was reduced from three to one. The redesigned format allowed one instructor to teach twice as many students as in the traditional format without increasing class size and without increasing workload. In the traditional format, each instructor taught one three-day-a-week section with 44 students. In the redesigned format, that same instructor taught two sections of 44 students and spent four hours tutoring in the lab. This could be accomplished because the class only met once a week and because no hand-grading was required. While the cost of adding tutors in the learning center as well as increased time for coordination and systems administration reduced the net savings, the redesign reduced the cost-per-student from \$121 to \$78, a 36% savings

[Northeast State Technical Community College \(NSTCC\)](#): NSTCC redesigned its developmental reading course, a traditional three-credit hour, lecture-based course. The course was taught in 24 small sections (~17 students) annually, 12 taught by full-time faculty and 12 taught by adjuncts. Employing multiple instructors led to course drift, creating inconsistency in the quality of course delivery. Small sections entailed a high delivery cost: the total cost of offering the traditional course was \$80,832. The redesigned course included one section each term of 275 (fall) and 137 (spring) students each. Each section was team-taught by two full-time faculty, and no adjuncts were used. The team added trained reading professionals to work with students in the Reading Center at \$15 per hour. The total cost of the redesigned course was \$39,639, which represents a savings of \$41,119, a 51% reduction. The savings generated by the redesign were placed into NSTCC's general fund to improve the education of all NSTCC students.

[Tallahassee Community College \(TCC\)](#): In its redesign of English Composition, TCC reduced the number of full-time faculty involved in teaching the course from 32 to 8 and substituted less expensive adjunct faculty without sacrificing quality and consistency. In the traditional course, full-time faculty taught 70% of the course, and adjuncts taught 30%. In the redesigned course, full-time faculty taught 33% of the course, and adjuncts teach 67%. Further savings were realized by reducing the amount of time and resources that the Writing Center staff had traditionally spent in working with students on basic skills. Mid-stage drafts were outsourced to SMARTHINKING, an online tutorial service. Overall, the cost-per-student was reduced from \$252 to \$145, a savings of 43%. Full-time faculty were freed to teach second-level courses where finding adjuncts was much more difficult.

[University of Alabama \(UA\)](#): 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 a Math Technology Learning Center (MTLC) open 65 hours per week.

Students also attended a thirty-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 six. Faculty time spent on the course declined by more than 20% and was redirected from presentation of material to interaction with students. 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% savings. Savings from the redesign were used to expand the MTLC facilities and fund redesigns of other math courses.

[University of Idaho \(UI\)](#): The University of Idaho redesigned three pre-calculus courses enrolling a total of 2,428 students by moving them to the Polya Learning Center modeled after the Virginia Tech Math Emporium. In the traditional format, the courses met three times per week in sections of ~50 students taught by lecturers and graduate students using the didactic lecture format. Out-of-class assistance was provided by a tutoring center. The university moved all structured learning activity to the Polya center where students received just-in-time assistance from instructors and undergraduate assistants. Instructors also met students in a once-a-week focus group that focused on student problems and built community among students and instructors. Faculty preparation hours were reduced by 27% while interaction time with students more than doubled. One faculty member coordinated the course and a Lab Manager supervised personnel in the lab. The redesign reduced the total cost of offering all three courses from approximately \$338,000 to \$235,000, a reduction of 31%. Savings generated from this redesign remained with the department to be reinvested in redesigning additional math courses to be taught in the Polya Center.

### **Further Opportunities for Cost Savings**

After several terms of fully implementing 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 vs. the number who move at a slower pace, scheduling complexities, and so on. 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 must include one of the strategies listed above which will result in immediate savings during the first term of full implementation.

## REDESIGNING DEVELOPMENTAL MATH THINGS YOU OUGHT TO CONSIDER

A number of innovative ideas emerged from NCAT's collaboration with the Tennessee Board of Regents (TBR) in its [Developmental Studies Redesign Initiative](#) for you to consider as you redesign.

Since the early 1980's, the TBR has operated a remedial and developmental math program comprising three courses taught primarily in traditional classroom settings in a 16-week format. The delivery strategy for courses offers a gradation of "basic remedial" (Basic Math), "basic developmental" (Elementary Algebra), and "intermediate developmental" (Intermediate Algebra). The same three courses (remedial and developmental) are offered at all of its 13 community colleges and the same two of those courses (developmental only) are offered at its six universities, helping to ensure a consistent experience for all TBR students regardless of location.

The TBR program also uses a uniform placement testing system. Students are placed in a remedial or developmental course if their ACT/Compass math subject scores are less than 19 or 29 respectively. Using ACT as an example, if students score 17 or 18, they are placed in Intermediate Algebra; if students score 15 or 16, they are placed in Elementary Algebra; if students score 14 or less, they are placed in Basic Math. Students are required to progress through one, two or three courses on a semester schedule until they exit Intermediate Algebra. Only then can they enroll in college-level math courses or their desired programs of study.

Three TBR institutions redesigned their remedial/developmental math programs with outstanding results. An overarching goal of each redesign was to streamline the amount of time that students--traditional and non-traditional aged--devote to remedial and/or developmental studies. That goal was achieved in each case by making many changes based on proven methods of integrating technology and learner-centered pedagogy. In addition, a number of new innovative ideas emerged that are described below.

### **1. Are you absolutely certain that the content of your remedial/developmental courses is NOT college-level?**

When [Jackson State Community College \(JSCC\)](#) redesigned the three remedial and developmental math courses, they replaced them with 12 clearly defined modules mapped to the competencies originally required in the three courses. Courses were divided as follows: Modules 1, 2 and 3 for Basic Math; Modules 4, 5, 6 and 7 for Elementary Algebra and Modules 8, 9, 10, 11 and 12 for Intermediate Algebra.

After the first full year of implementation of their redesign JSCC mapped their competencies to ACT's College Readiness Standards by score range. ACT defines "readiness" for college-level math at a score of 22 and above. JSCC discovered that Modules 1 – 3 (Basic Math) mapped appropriately to the score range 16 – 19. They also discovered that 11 of the 20 competencies included in Modules 4 – 7 (Elementary Algebra) mapped appropriately to the score range 16 – 23 but that 9 of the

competencies mapped to the score range 24 – 32 (i.e., were college-level competencies rather than developmental, according to ACT.) They also discovered that all but one of the 22 competencies included in Modules 8 – 12 (Intermediate Algebra) mapped to the score range 24 – 32 (i.e., were college-level competencies rather than developmental, according to ACT.)

This means that students in developmental math (e.g., with an ACT score of 17 or 18) are, in essence, being held to a higher standard than students who are not in developmental math (e.g., with an ACT score of 19 or 20). This insight is leading JSCC and other TBR institutions to re-consider what is developmental vs. college-level course content.

***For your consideration:*** Have you examined whether or not you are teaching college-level math in your remedial/developmental courses and, if so, how much? Are you unnecessarily prolonging the student experience by doing so?

## **2. Are you remediating high school deficiencies in your remedial/developmental courses or preparing students to succeed in college?**

ACT studies show that 80 - 90% of students need an assortment of skills from Basic Math, Elementary Algebra, Geometry and Statistics to succeed in college-level math courses, and they do not need as much Algebra as the traditional remediation approach provides.

Jackson State Community College (JSCC) recognized that student goals are different: they may plan to enter a program of study that requires advanced mathematics, to complete a general education mathematics course or to apply for admission to a nursing or allied health program. Consequently, JSCC's redesign moved away from remediating students' high school algebra deficiencies to preparing students for their particular educational goals. Students were required to master only the concept deficiencies that were relevant to their educational and career goals.

After defining the competencies to be included in each of the 12 modules, the math faculty determined which modules were necessary to succeed in each college-level general education math course. All other departments identified which modules were necessary to succeed in their college-level courses as well as their discipline's core math requirements. Departments with programs not requiring college-level math determined the modules necessary to succeed in those programs. Changes in developmental math prerequisites were approved by the college curriculum committee.

Of the 48 programs of study at JSCC requiring college-level math courses, 35 required only seven modules (47.1% of the students); four required eight modules (31.2% of the students), and seven required all 12 modules (20.3% of the students). One program required only six modules (0.8% of the students), and one required only four modules (0.6% of the students).

Students were advised of their multi-exit opportunities based on their program of study choice and of the need to take more modules if they later changed their majors. This was accomplished via information sheets for each major, focus-group sessions and individual counseling with math instructors and the students' academic advisors. The

team made a campus-wide presentation at an in-service training and conducted sessions for advisor training in order to educate the college faculty and staff.

By changing the requirements for developmental math completion, JSCC should be able to reduce the number of sections/modules they needed to offer by 31%. As an example, during the 2008-09 academic year, 1836 students were enrolled in developmental math. JSCC needed to offer the equivalent of 15,241 modules to serve these students under the new policy. Assuming similar placement distributions, JSCC would have had to offer 22,032 modules under the old policy.

**For your consideration:** Are you looking backward or forward? Are you remediating high school algebra deficiencies in your remedial/developmental courses or preparing students to succeed in college? Are you preparing all students to succeed in STEM majors, even though most will not major in a STEM field?

### **3. Are there simpler alternatives to complicated diagnostic assessments after placing student in remedial/developmental courses?**

When Jackson State Community College (JSCC) redesigned the three remedial and developmental math courses, they replaced them with 12 clearly defined modules mapped to the competencies originally required in the three courses.

JSCC experimented with module placement by ACT scores and by Compass scores. They found that over 95% of the students would have been placed above their deficient level if ACT or Compass placement were the only tool used. They concluded that while the ACT and Compass tests may be sufficient to determine whether or not a student is college-ready for mathematics, they are not appropriate diagnostic tools to determine mastery of specific competencies.

Consequently, JSCC developed their own diagnostic assessment using MyMathTest that corresponded to the competencies in the 12 modules. Of the 1067 new students tested in fall 2007 and spring 2008, only 3% of the students did not need to study the competencies in Modules 1 – 3 (Basic Math). Based on these results, JSCC decided that requiring students to take the additional diagnostic assessment was a waste of time since 97% of the students tested into Module 1.

Instead, JSCC now requires all students who place into remedial/developmental courses via ACT or Compass to start at Module 1 and take a pre-test. If the pre-test score is 80% or above, the student is deemed to have successfully completed the module and moves on to the next module, again taking a pre-test, and so on. A student scoring less than 80% on any given module completes the work required for that module and takes a post-test to complete the module. Now each student passes each module, proving mastery of each skill rather than a general level of competency as indicated by ACT/Compass scores.

**For your consideration:** Do you really need to administer diagnostic assessments beyond your initial placement test? Doesn't it make more sense to allow students to "challenge" each module by passing a test, moving quickly through early modules when possible, ensuring that each module competency has been mastered?

### **4. Is there a cost-effective way to offer low-enrollment sections?**

Every campus faces class times that historically have low enrollment numbers. Cleveland State Community College (CSCC) quickly realized that it is possible to offer multiple courses in the same classroom at the same time because the Emporium Model individualizes instruction for each student. Students progress through their courses individually, and instructors provide assistance to each student as needed. Multiple courses can be offered in either a large computer lab or in a small computer classroom.

Some campuses also face low enrollment in math courses at smaller branch campuses, which often means that those courses cannot be offered each term. This creates scheduling roadblocks for students and may prevent them from completing their degree requirements on time. Scheduling more than one course in the same classroom at the same time when enrollment in the courses is small has enabled CSCC's math department to increase course offerings at all campuses and meet students' program needs better than ever before. In essence, they are offering "math on demand."

Cleveland State calls this strategy "reinstating the one-room schoolhouse."

***For your consideration:*** 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?

## Five Critical Implementation Issues

From the experience of the 30 projects involved in the [Program in Course Redesign](#), we have identified the five most important implementation issues that they encountered. Some of these issues were faced by only a few institutions, but when the problem occurred, it created a major obstacle for the redesign implementation. Others were faced by a number of institutions. Some institutions did not encounter these issues because they foresaw them and dealt with them in advance. Others did not anticipate the particular problem and had to deal with it in mid-project. Some worked on solving the problems constructively and ended up with successful redesigns; others “backslid” and abandoned key aspects of their redesign plan. We refer to these implementation issues as “critical” because planning how you will deal with them can be the key to achieving success in course redesign.

We encourage you to pay special attention to how you will:

1. Prepare students (and their parents) and the campus for changes in the course.
2. Train instructors, graduate teaching assistants (GTAs), and undergraduate peer tutors.
3. Ensure an adequate technological infrastructure to support the redesign as planned.
4. Achieve initial and ongoing faculty consensus about the redesign.
5. Avoid backsliding by building ongoing institutional commitment to the redesign.

### **1. Prepare students (and their parents) and the campus for changes in the course.**

Making the change from traditional classroom instruction to new ways of learning involves far more than learning to use a computer. Many students are set in their ways after a lifetime (albeit brief) of passive instruction. They need preparation in making the transition to more active learning environments. Giving careful thought to how students, their parents and the rest of the campus community will learn about the redesigned course will help you avoid a number of problems that can arise.

*[University of Southern Mississippi](#) Example:* “Initial stories in the campus and local press emphasized the technology of the course, especially its online dimensions, and pitched making life easier as students could ‘come to class without leaving home.’ The stories frightened many students, angered faculty, and confused administrators as parents phoned them to ask for details about an ‘instructorless’ course that was still in the design stage. In hindsight, a better approach would have been to emphasize how traditional the course could be for students who chose that path: students could still attend live presentations and participate in discussions; WebCT was already being used in hundreds of other campus courses; and there would be more in-person help and office hours available than ever before with a nine-person team (four faculty instructors, four graduate assistant graders, and a faculty coordinator) collectively offering the redesigned course rather than the sole instructor of a ‘normal’ course. It would have been better to insist that the press stress educational ends rather than technological means from the outset. Although improved reading and writing skills will always seem less newsworthy than stories about streaming video, it’s

nevertheless crucial to keep a clear focus on why the technology has been called into play in the first place.”

[University of Dayton](#) *Example:* “Student surveys revealed that a major contributor to students’ pre-course attitudes toward distance learning was the belief that the course would be impersonal and would lack opportunities for student-student and faculty-student interaction, even though they had never participated in a distance-learning course. The course needed to be promoted among students, faculty, and staff. A Web site that included a demonstration version of the course was an effective promotional tool. The university needed to develop and communicate to parents and students a coherent and compelling description of its e-learning initiatives that addressed common misconceptions and concerns (e.g., that the university is turning into a ‘distance learning’ campus). This requirement will change as everyone on campus becomes more familiar with distance learning.”

[University of Alabama](#) *Example:* “The radical change in instructional style associated with the course redesign produced some unique issues not typically associated with the traditional course structure, what the team dubbed the ‘No Teacher Syndrome.’ During the first year of implementation, students were very concerned about the lack of a formal teacher for their course even though they had one-on-one instructional support available at all times. In an effort to develop a personal relationship between students and instructors, weekly 30-minute ‘class’ sessions were scheduled, an automated e-mail system was developed to allow instructors to contact their students on a weekly basis, and the time instructors spent in the lab was fixed and publicized to allow students to come to the lab at specific times and deal with the same instructional staff.”

## **2. Train instructors, graduate teaching assistants (GTAs), and undergraduate peer tutors.**

Several projects experienced problems because they underestimated the degree of instructor, GTA, and undergraduate tutor training—both initial and ongoing—that was required in order to implement their redesigns successfully. Regardless of the redesign model chosen, the new format will inevitably require very different kinds of interactions with students than those of the traditional teaching format. Developing a formal plan for initial and ongoing training of all personnel—rather than assuming they will pick up the new methods on their own—will go a long way to ensuring a successful redesign.

[University of Tennessee-Knoxville](#) *Example:* “Initially the team overestimated the level of GTA preparedness and underestimated amount of training needed. Many of the GTAs had no experience in an online environment and were not prepared to help the students when they asked questions or encountered problems. Although training was held prior to the start of the pilot term, the team discovered that there was a need for ongoing training and stronger continuing GTA support than was initially planned. As the course numbers scaled up toward full implementation, the Instructional Technology Center increased the amount of GTA/instructor training on the course management system and exposure to the course structure to compensate for those with limited technology skills and/or experience. Because many of the GTAs were Master's candidates with minimal

or no teaching experience, their readiness to engage in a newly designed learning environment was also low.”

[University of Alabama](#) *Example:* “Training instructors, graduate teaching assistants, and undergraduate tutors to ‘teach’ in the lab has been a major challenge. The one-on-one assistance the computer-based format requires was very different from the teaching format the instructors had used and/or experienced in the past. The university has expanded training for instructors each semester to better equip them to provide assistance to students in the Math Technology Learning Center.”

[Drexel University](#) *Example:* “The desire to go back to old ways of doing things had to be overcome by both faculty and students. Once this occurred, many embraced the new system as providing a better learning experience. As new faculty, teaching assistants, and students were brought into the course over time, it was important to help them go through the same steps of accepting a different learning model and to point out ways of creating the type of connections attributed to the traditional lecture format. Laboratory assistants needed to be coached in how to facilitate and engage students in problem-solving rather than in resorting to lecturing or providing answers to students. Thus a formal training system with follow-up monitoring was needed for new faculty, teaching assistants, and laboratory assistants so they could fully adapt to the course redesign.”

### **3. Ensure an adequate technological infrastructure to support the redesign as planned.**

Technological problems encountered by the projects were of two kinds. The first kind of problem had to do with providing enough space in a timely manner to support the redesign model. Securing an upfront commitment from the institution regarding necessary space (or choosing a model that is not as space-dependent) will ensure that the project avoids implementation delays. The second kind of problem had to do with scaling issues. Many campuses have only offered relatively small online courses. Offering a course with heavy online components to hundreds—or thousands—of students requires a serious consideration of the technological infrastructure required to support it.

#### Space Issues

[University of Iowa](#) *Example:* “Full implementation was delayed by a lack of available laboratory space. At the time of the proposal, the university made a commitment to transferring lab space from botany to chemistry. A delay in construction and botany’s move meant that those facilities could not be used. An organic chemistry lab was finally transferred to support the redesign course.”

[Iowa State University](#) *Example:* “At the time the project began, the College of Liberal Arts and Sciences was planning to create a centralized computer lab. These plans did not succeed as scheduled, so the course was not fully implemented on the planned scale. This problem has now been resolved. About one-third of the course was redesigned in fall 2003, and the full course will be redesigned in spring 2004 and beyond.”

[University of Idaho](#) Example: “Finding sufficient space in an easily accessible and convenient location for the Polya Center required rehabbing space and relocating some offices. Now housing 71 computers in pods of four that are designed for as many as three students to work together at a single monitor, the Polya Center provides a learning environment for over 2400 students annually. To accommodate this large number of students, the Polya team has spread the load of student use more evenly by spreading assignment deadline dates across each day of the week. Thus 20% of students have deadline dates for assignments, tests and quizzes on Monday, 20% on Tuesday, and so on. The space is used more consistently, rather than just before a test or assignment is due, allowing more students to be accommodated in a smaller lab and reducing the lab downtime.”

### Scaling Issues

[University of New Mexico](#) Example: “The keystone for the success of the redesigned course was the randomly generated mastery quiz. Students would take a quiz many times in order to achieve a perfect score. Often they would continue taking quizzes even after having attained a perfect score. The ability to offer literally thousands of quiz items per student per week and to provide immediate feedback on performance could not have been achieved without the availability of online quizzing. Psychology, however, was the only course placing this degree of demand on the university’s WebCT server. There are now concerns that the server may not be able to continue to meet present demands, let alone future demands if other courses were to implement the multiple quiz design.”

[Portland State University](#) Example: “The technology created a considerable obstacle for a significant minority of students. Surprisingly, it was not the computer illiterate who encountered the most difficulty, but the students who insisted on performing all online activities from their home computers, where we could not provide technical assistance. Although all students were strongly encouraged to use university computer labs, about 90% did their activities from home, with about 10% of them experiencing chronic frustration. Both the Spanish program and the university continue to develop new WebCT training materials for student and instructor training.”

[University of Tennessee-Knoxville](#) Example: “Technological problems constituted the most important implementation issue experienced by most students at each phase of implementation and one that continues to be a challenge. The first four to five weeks in the pilot term were extremely problematic due to server problems. Students were frustrated and anxious, and instructors complained about the amount of time they had to spend resetting activities, responding to student email questions and complaints, and discussing technology-related problems in class. These frustrations were magnified as a result of increased class sizes. The technological problems were rooted in a glitch in the server. After the problems were resolved, there was a substantial reduction in student complaints. In a subsequent term, the course management system and delivery servers were upgraded to the more robust enterprise version of Blackboard. After these changes, there were only minor problems and the

feedback from both instructors and students was quite positive. In collaboration with the course coordinator, the technical and instructional support staff have worked diligently to rectify technical problems and increase instructor support.”

#### **4. Achieve initial and ongoing faculty consensus about the redesign.**

The biggest implementation issue for several of the projects was achieving consensus about a variety of issues among all faculty teaching the course. Since course development is usually done by a single faculty member working on a single course, the redesign of an entire course by multiple faculty can present a number of challenges such as gaining agreement on core course outcomes, instructional formats, topic sequences and a common Web site. Since instructors are often not used to talking about such issues, they need time to work through them. As several projects have commented, however, this can be a "good" problem to have. Collective decision-making and departmental buy-in are key factors that lead to successful redesigns.

[Tallahassee Community College](#) *Example:* “While the English faculty agreed to the redesign initially, once it was accomplished there was some opposition from several faculty members. In retrospect, the team needed to do a better job of communication and inclusion and actively involve the other 16 full-time faculty in improving redesign components and course evolution. This has been largely overcome and is not an issue with adjunct faculty.”

[Riverside Community College](#) *Example:* “The large number of faculty engaged in the redesign (24 spread among three campuses) led to a very complex redesign organization. Various committees created a common syllabus, common tests and finals that ensure that course outlines of record are being followed, a common grading metric that ensures that academic standards are upheld, and lab worksheets. Accomplishing these tasks required significant time and reaching a consensus on topics required patience and a lot of give-and-take. The discussion that resulted among faculty at all three campuses regarding student performance after the assessment of the redesign was also an unexpected, positive outcome.”

[Fairfield University](#) *Example:* “Since some traditional lectures were replaced by computer activities each semester, less time was available to cover the necessary material in the traditional lecture format. Thus, some lecture material that has become obsolete in today's science was eliminated, as were certain laboratory exercises that are simply procedural rather than inquiry-based. Instead, the team relied on particular software activities as assignments outside of class to emphasize the detail in biological concepts. The team had strong backing from most of the department, including freedom and encouragement to redesign the course syllabus as appropriate. The team has, however, been constantly faced with the challenge of obtaining faculty buy-in from the entire department. Thus far, they have been able to convince the majority that the changes will enhance learning without sacrificing content. The team has concluded that being effective change agents does not require complete buy-in if there is core support.”

## **5. Avoid backsliding by building ongoing institutional commitment to the redesign.**

You will undoubtedly notice that we emphasize institutional commitment to course redesign, and that includes building and sustaining that commitment throughout the life of the project. In the course of implementing a redesign, things happen. Lead faculty members leave or retire; departments get reorganized; presidents and provosts get new jobs. Faculty members on their own can show (and have shown) spectacular success in creating highly effective new learning environments, but in order for these successes to be sustained or for them to have a real impact on the institution as a whole, both departmental and institutional administrative leadership needs to play an active and continuing role.

You will inevitably encounter problems in implementing your redesign as you make a transition to a new form of instruction. Without a full commitment to preserving the key elements of the redesign while addressing the problems you encounter, the institution may simply abandon the redesign, thus forgoing either the learning gains or the cost savings benefits or both.

*University of Dayton Example:* “Our greatest challenge involved institutional support. Some administrators viewed this redesign project as a grand experiment or test case. The project has exposed a number of issues that need to be addressed, regardless of the success of our redesign. Our intellectual property policy needs to be revised to cover the development of online courses. The university needs to develop and communicate to parents and students a coherent and compelling description of our e-learning initiatives that addresses common misconceptions and concerns (e.g., that the university is becoming a “distance learning” campus). Far from being an insulated and isolated project, this redesign was simply the first of many such efforts. The more that the university can do now to learn from and address the larger support and public relations issues raised by this project, the easier it will be for future redesign teams.”

*Drexel University Example:* “In the middle of the project, the department of mathematics and computer science was split into independent departments in different colleges. The importance of having strong support from departmental (and university) leadership became increasingly clear after the department was split. Team members ended up in both departments, which created conflicting priorities that affected the pace of redesign. Unlike the joint department head, the new computer science department head was not a member of the redesign team, which resulted in a change in project scope because of a decision about how the target courses would be used. The fragility of creating and sustaining major pedagogic change under changes in leadership, which may bring changed priorities, was evident. Existing redesign features at the time of the split have been sustained and more fully developed, but aspects of the redesign that were not yet in place have been problematic to initiate due to changing interests and changing personnel. The project team is still working to achieve all of the redesign goals; however, the pace of implementation has been slowed.”

Riverside Community College *Example*: “The three RCC campuses successfully implemented the full redesign with all 3600 students, demonstrating increased student learning gains and decreased costs. Nevertheless, some faculty preferred the old model. In response to that faculty preference, a number of changes occurred on the three campuses. In fall 2002, RCC began offering a choice of either the redesigned or traditional lecture format at two of the campuses. Altogether 11 redesigned sections (enrolling 805 students) and 10 traditional sections (enrolling 500 students) were offered. The third campus has developed a model that uses the redesign model but also incorporates pencil and paper homework requirements. Topics and term schedules are still coordinated between two of the campuses because some students use labs on both campuses; however, tests are developed independently. Although the workshops on math study skills and time management were successful, they are no longer part of the redesigned course. These techniques have been combined into a credit course not applicable to a degree, which is offered occasionally.”

## **Course Redesign Planning Checklist**

The following set of questions can act as a final checklist to ensure that your redesign plan has taken the key elements of successful redesign into account. If you are able to answer each of these questions thoughtfully and concretely, your plan has an excellent chance of achieving its academic and financial goals and benefits for students, faculty and your institution.

### Course Organization

How will students to be actively engaged with course content?

How will you provide students with more individualized assistance than you were able to offer in the traditional format?

How do you plan to incorporate ongoing assessment and prompt feedback for students? Will these activities be a mandatory part of the course?

How will you ensure that students spend sufficient time on task? How will you monitor student progress? How will you deal with students who are falling behind?

### Cost Reduction

Have you considered what aspects of the course require face-to-face time and what aspects of the course can be conducted online?

Do you have a plan to automate grading where possible (e.g., low stakes quizzes, homework exercises, and so on)? How will this be accomplished?

Have you thought about how to increase the person-to-person assistance available to students? Who will do this and how?

Have you considered the use of various kinds of personnel that can provide needed student assistance and to complete administrative tasks (e.g., undergraduate peer tutors, graduate teaching assistants, course assistants, preceptors, and so on)? Who will do what?

Have you considered combining multiple sections of the course into a fewer number? Have you thought about a division of labor among multiple faculty members in order to reduce duplication?

Have you consulted with administrative staff (e.g., registrar, facilities planners, IT staff) about the impact of your redesign on their functions?

### Assessment of Student Learning

Have you selected a method for obtaining data to compare student learning outcomes (e.g., parallel sections vs. baseline) during the pilot phase?

Have you selected a method for obtaining data to compare student learning outcomes (e.g., baseline data from “before” the redesign vs. baseline data from the pilot) during the full implementation phase?

Which of the four measurement methods will you use?

Do you plan to conduct other comparisons between the traditional and redesigned format? How do you plan to do this?

Are you prepared to compare course completion results for both the pilot and traditional phases? Do you have baseline data on course completion for comparative purposes?

### Implementation

Do you have a plan to prepare students (and their parents) for the transition from the traditional format to the new format? How will you do this?

Have you established ways to assess and provide for learner readiness to engage in IT-based courses? How will you do this?

If your course involves teaching assistants, adjunct faculty or undergraduate peer tutors, how will you orient and train them?

How do you plan to move beyond the initial course designers and enlist other faculty in teaching the redesigned course?

How will you ensure student access to computers, the network and any other technological resources they need?

How will you provide technical support for students in navigating instructional software, using course-management systems, and so on? Who will do this?

Do you have adequate laboratory classroom space and equipment to offer the course in the redesigned format?

How will you deal with software changes and updates?

Can the software products you have selected accommodate large number of students (e.g., 25 vs. 200)? Are your servers adequate for the scale of your redesign?

Have you achieved initial consensus among all faculty teaching the course about curricular issues including:

- core course outcomes
- topic sequences
- instructional formats
- textbook selection
- a common Web site (e.g., terminology and interactivity)

How do you plan to achieve ongoing faculty consensus about the redesign?

How do you plan to achieve ongoing departmental and institutional commitment to the redesign?

## **The Emporium Model How to Structure a Math Emporium Advice from NCAT's Redesign Scholars**

In redesigning introductory mathematics courses, NCAT's partner institutions have found that the Emporium Model has consistently produced spectacular gains in student learning and impressive reductions in instructional costs.

Two different versions of the Emporium Model have been successful. In both versions, mandatory attendance (e.g., a minimum of 3 hours weekly in the emporium) ensures that students spend sufficient time on task and receive on-demand assistance. In both versions, mandatory weekly group meetings enable instructors to follow up where testing has identified weaknesses or emphasize particular applications. Group activities help build community among students and with instructors.

**Flexible Attendance:** Mandatory lab hours may be completed at the student's convenience. Examples:

- [Cleveland State Community College](#): Basic Math, Elementary Algebra and Intermediate Algebra
- [Louisiana State University](#): College Algebra
- [The University of Alabama](#): Intermediate Algebra
- [The University of Idaho](#): Precalculus

**Fixed Attendance:** Mandatory lab hours are scheduled by the institution for student cohorts. Examples:

- [Jackson State Community College](#): Basic Math, Elementary Algebra and Intermediate Algebra

NCAT Redesign Scholars Phoebe Rouse and Kirk Trigsted originally created this FAQ to answer commonly asked questions about how to structure math courses using the Emporium Model. The FAQ has been modified to differentiate between the two versions described above, which reflect new implementations of the original model that adapt to particular institutional constraints. For some questions, the same answer applies to both the Flexible Attendance and Fixed Attendance versions. For other questions, the answers are different.

### Course Structure

Q: Should lab hours be required?

A: Don't even bother to redesign if you are not going to require lab hours. There are mixed opinions about whether or not students' required hours should be reduced throughout the semester if they earn a certain grade on each test. Some institutions, for example, lessen the required time in the lab if a student earns a B or better; others do not lessen the required time.

Q: How many lab hours should be required each week?

*Flexible Attendance A:* In most institutions, for a three-credit-hour course, three hours are required in the lab (along with one hour required in the classroom). For a five-credit-hour course, five hours are required in the lab (along with two one-hour meetings required in the classroom).

*Fixed Attendance A:* In most institutions, students are divided into course sections and meet at fixed (scheduled) times in the lab with an instructor equivalent to meeting times in the traditional format—i.e., two or three times a week. In addition, students may also meet with the instructor in a classroom for one hour per week.

NOTE: At some institutions, students only meet in the lab—i.e., there is no weekly focus class meeting.

Q: If we only meet in a classroom once a week, how can we possibly teach a week's worth of material in 50 minutes?

A: Don't try to "teach a week's worth of material." The goal of the weekly class meeting is to focus students' attention on the week's upcoming tasks. Here are some tips for what instructors should do in a weekly class meeting:

- Start out with a short recap of the previous weeks' material, especially if it leads into new material.
- Give an overview of the week's new material.
- Cover important concepts and work especially difficult examples, pointing out common errors.
- Focus on examples that combine multiple skills and concepts.
- Review the schedule of work due for the week.
- Discuss study strategies.
- Be sure to take attendance.
- Above all, do not try to cram in a traditional lecture and do not go over homework.

Q: How can students possibly learn the material if we don't teach it to them?

A: About 75% of the student learning takes place in the lab setting. The instructor role in the classroom is to guide students, pull concepts together and help them avoid common pitfalls. Your role as sage-on-the-stage is diminished. You trade that role for tutor-in-the-trenches while students are doing their work independently. This is a huge adjustment for many experienced instructors and inexperienced instructors as well.

Q: How many students should be in the weekly class meeting?

A: Careful consideration should be given to the size of a section. Most institutions' sections contain between 25 and 45 students, which works well. Some institutions have much smaller sections, and others have much larger sections (some have 80 and a few have as many as 300.) Regardless of the size, the key point is to structure the activities of the weekly class meeting as described above.

Q: Doesn't the Emporium Model reduce the interaction between students and instructors?

A: On the contrary, there is more interaction between students and instructors than ever before, and that interaction is more meaningful, more individualized and more focused. The main reason why students learn better in this model is that they are less passive and more actively involved doing math, and they receive help based on their individual needs.

Q: How do we get students to go to the weekly class meeting and to the lab?

A: You will never get all students to attend the weekly class meeting or put in the required hours, but you can get most students to attend regularly by making class and lab participation at least 10% of the final grade. (Some advocate giving a higher percentage for participation.) This is extremely important. Without giving course points for participation, success rates will be very low.

Q: Can students do homework and quizzes outside of the lab?

A: Absolutely. Encourage students to work as much as possible on math anywhere and anytime, but only give participation credit for time spent in the lab with tutors available and with certainty as to who is doing the work.

### Course Personnel

Q: Who should be responsible for the course?

*Flexible Attendance A:* Some one needs to take overall responsibility for ensuring that the course works well, that all students have the same learning experiences and assessments, and that all course policies and procedures are implemented consistently. Make sure that you have a course coordinator who can offer the necessary leadership. At the same time, it is important to emphasize teamwork and to involve others in the decision-making process.

*Fixed Attendance A:* Instructors are responsible for their individual sections as in the traditional format. In smaller institutions, the department chair usually has overall responsibility for ensuring that the course works well, that all students have the same learning experiences and assessments, and that all course policies and procedures are implemented consistently. In larger institutions, a course coordinator may assume that responsibility.

Q: How much training is needed for instructors?

A: Instructors working in a redesigned setting for the first time need enough training to understand the new philosophy of teaching that is required because a change in the basic mindset must take place. Some people embrace this change immediately, while others may have to be dragged along. Here are some tips:

- Plan to get instructors involved as early as possible.
- Involve instructors in curricular decision-making.
- Offer workshops with discussions and presentations.

- Bring in guests from other schools that have successfully implemented an emporium.
- Hold a workshop for instructors new to redesign at the beginning of each semester.
- Then hold a meeting with all instructors for the semester to review old policies and point out any new ones.
- As the semester progresses, meet frequently with all instructors to offer ongoing training. Some institutions meet weekly, others meet on a less regular basis.

Q: How does the instructor's role change?

A: Faculty members no longer spend time preparing lectures, grading homework or preparing and grading tests. Therefore, they can dedicate more time to helping students. The faculty role becomes one of facilitator of student learning and guide of each student's study in math. Instructors meet with classes, in or out of lab, tutor students, counsel students, monitor each student's progress and provide support and intervention as needed. Instructors may also lead small-group discussions on topics particularly difficult for groups of students.

Q: What redesigned teaching load is equivalent to a traditional three-credit-hour course?

A: There is no simple answer to this question since every institution and every department has a different set of "rules" (policies and procedures) in regard to faculty load. Redesign will require you to revisit some of those rules because of the way that redesigned courses are structured. A teaching assignment that used to be a three-day-a-week hour-long lecture with paper assessments is now very different since the software both provides most of the "lecture" and automates most of the assessments.

A common assumption in higher education is that instructors spend two hours outside of class (preparing and grading) for every one spent in class. That means that a three-credit course typically requires the instructor to spend nine hours per week on the course. Since both the in-class time and the preparation and grading time are reduced in the Emporium Model, you need to reallocate instructor time accordingly. This might translate to something like two one-hour weekly class meetings, two hours for preparation and five hours in the lab tutoring students each week. You will need to make decisions based on your own institutional "rules" and the changes you have made in the redesigned course structure.

In addition, many institutions ask instructors to schedule some of their office hours in the lab, which adds to the number of hours they spend in the lab, so that they can provide assistance to all students in the lab when they do not have scheduled appointments with their own students.

Q: How many tutors will we need in the lab?

*Flexible Attendance A:* For the first three to four weeks, you will need one tutor for every 15 students. As the semester progresses and students become familiar with the lab and the software, that ratio drops down to 1:25 and often is as low as 1:40 by the end of the semester. If testing is done in the lab, be sure to have an appropriate test proctor (rather than student tutors.)

*Fixed Attendance A:* In this version of the Emporium Model, instructors meet with their individual sections in the lab at fixed times. Additional tutors may be needed during those times and are definitely needed at times when the lab is open but there are no scheduled classes. The ratios described above for later in the semester then apply. If testing is done in the lab when classes are not scheduled, be sure to have an appropriate test proctor (rather than student tutors.)

Q: Who are the lab tutors?

A: You will need your instructors to tutor in the lab; their presence is essential. In addition, undergraduate math majors and other interested undergraduate students make excellent tutors. Volunteers from the community such as retired high school teachers can be used to tutor. Adjunct faculty may be paid extra to work additional hours in the lab. Math graduate students can also be used if they are available. All tutors must be trained to guide and lead students along rather than just giving students the answers.

### The Lab

Q: How should we track lab participation?

*Flexible Attendance A:* You will need a system to track students using a commercial product or a homegrown program. Most institutions use a card swipe with student IDs and have some mechanism to move this information to specific instructors on a weekly basis by email or by direct download to grading software.

*Fixed Attendance A:* Instructors take attendance via a sign-in sheet when their sections meet in the lab. For institutions that also require students to spend additional hours in the lab, you will need a system as described above.

Q: How can we smooth out demand for the lab throughout the week?

*Flexible Attendance A:* While there are typically peak usage times in the lab, it is important to stagger your due dates and your weekly class meeting times to spread out demand on the lab since most students tend to do their work at the last minute--i.e., don't have all weekly class meetings on the same day of the week and don't have all assignments due on the same date of the week.

*Fixed Attendance A:* In this version of the Emporium Model, demand is smoothed out by scheduling weekly class meetings appropriately.

Q: What are the peak times in the lab?

*Flexible Attendance A:* Of course, this varies among institutions, but many institutions have peaks around 10:30 AM, 1:30 PM, and again around 6 PM. For some unknown reason, it appears that Tuesday afternoon is the busiest time at many institutions. Keep track of lab attendance every quarter hour, put this in a table and study it to determine staffing decisions for future semesters.

*Fixed Attendance A:* In this version of the Emporium Model, peaks are managed by scheduling section meetings appropriately.

Q: How do we determine how many computers we need in the lab for students?

*Flexible Attendance A:* This is a difficult question to answer without knowing specific facts about your particular situation. Here are some things to consider:

- There is obviously a relationship between the number of hours that the lab is open and the number of computers needed. (The more hours you are open, the fewer computers you need and vice versa regardless of the number of students enrolled in the course.)
- You should carefully stagger your due dates and your weekly class meetings to even out the times students go to the lab.
- Even with careful scheduling, all open labs experience peak attendance periods (for some it's late afternoon and early evening; for others it's early afternoon and early evening.) Planning must take this into account—i.e., you do not want students arriving at the lab to find that all computers are taken.
- You should determine when the lab will be open based on your institution's demographics, especially when students tend to be on campus.
- If possible, create a space within the lab for students to use their own laptops to supplement the number of pcs you need.

Many of the redesigns that use the Emporium Model have large number of students and keep their labs open 60 or more hours per week. In addition, their campuses are primarily residential, which means that student participation is relatively evenly distributed throughout the day. Their experience, based on requiring three hours of lab participation per week per student and keeping the lab open 60+ hours per week, translates into the following rule of thumb:

The number of computers required = the number of students/15 if you do not test in your lab or the number of students/11 if you do test in your lab.

Examples without testing

1000 students/15 = 67 computers

800 students/15 = 53 computers

500 students/15 = 33 computers

Examples with testing

1000 students/11 = 91 computers

800 students/11 = 73 computers

500 students/11 = 46 computers

While the numbers shown above translate roughly to 4 computer hours per student if you do not test and 5.5 hours per student if you do test, the large number of open hours and the relatively even distribution of student participation are necessary components of making those ratios work. Once your lab is open fewer hours, which may be necessary because of staffing constraints, lab availability or student attendance patterns, these ratios do not hold. Smaller numbers of students and smaller numbers of open hours create additional constraints that require special attention in order to make an open lab work.

Example  
200 students  
Lab is open 20 hours per week  
Requires 40 computers  
Ratio = 5:1

Example  
240 students  
Lab is open 12 hours per week  
Requires 120 computers  
Ratio = 2:1

*Fixed Attendance A:* If you do not have a large lab and/or your numbers are small, we strongly recommend that you schedule lab hours for students rather than rely on an open lab in order to be sure that the number of computers available match student demand. What is most important in the Emporium Model is that students are working in the lab the requisite number of hours, not the flexibility of those hours. Block scheduling can be equally effective as open scheduling in this model.

While the lab should include sufficient numbers of computers for each student to have one during scheduled times, some additional computers should be available for those students who would like to work additional hours in the lab beyond the scheduled meeting times.

Q: Should students get partial credit for spending part of the required time in the lab?

A: There is some disagreement on this, but most institutions do not give partial credit. The reason for not doing it is that if you do, students will decide what grade they want and spend only that percentage of the required time in the lab. Unfortunately, they often misjudge.

Q: How can we stop students from doing things other than math in the lab?

A: You need strict rules and you need to enforce them. Students caught violating the policy must have a severe penalty such as losing participation credit for the week. Be sure to put this in the course syllabus. Lab computers can be set to allow access to only certain IP sites, and tutors walking around the lab can observe what students are doing.

### Assignments

Q: When should quizzes and tests be due?

A: This varies a bit based on the specific model, but in general homework should be due either the night before or two nights before the weekly class meeting. Often quizzes are due the night before the weekly class meeting.

Q: What assignment setting is best for homework, quizzes and tests?

A: *Homework:* should be open from the beginning of the semester with unlimited attempts prior to the due dates. Feedback should be immediate with the opportunity to rework an exercise until mastery. Mastery levels can be set before students are allowed

to move on to the next homework assignment. Students should use all tutorial resources available to them for homework.

*Quizzes:* should be set so that no tutorials and no feedback are allowed until submission. Remember that quizzes are preparation for tests. Students should be given many attempts to retake quizzes. A common number used with success is 10 attempts. Questions on quizzes should be pooled so that additional attempts allow students to see a range of exercises within one objective. Students should not be able to go back and rework individual exercises on a quiz to improve their grade on it. Often quizzes are timed to give students a more realistic sense of the upcoming test situation. The best score should be kept to encourage students to continue to take a quiz to improve their grade or just to get additional practice with no penalty.

*Tests:* can be attempted just once or multiple times depending on whether or not some plan is in place to require time to pass for students to re-prepare for a retake. This often depends on the resources of the institution and the level of the course. Multiple testing opportunities are a must if mastery is required.

Q: How should we handle testing?

*Flexible Attendance A:* This is a difficult question to answer without knowing specific facts about your particular situation. Here are some tips that apply to most situations.

- Stagger the testing schedule to reduce overloading the lab.
- Allow students to schedule their tests online if the testing schedule can be flexible. If you do this, give a deadline for students to schedule. Beyond that deadline, students have in effect missed the test and get a grade of zero. This may sound harsh, but if you don't do this, you will have a huge mess that is unfair to students who followed the policies.
- Allow students to take their test before the deadline as long as there is a test proctor present so that they can proceed through the course at a faster rate.

*Fixed Attendance A:* In this version of the Emporium Model, testing is managed within the weekly class meeting. At some institutions, students are permitted to test anytime the lab is open and an approved test proctor is present.

Additional tips:

- Provide scratch paper for students using varying colored paper, pick up the paper as students leave, and shred the paper after the testing window closes. Some institutions return this paper to students. If you choose to do this, be sure to have a system in place.
- Watch calculators carefully. Many new scientific calculators have symbolic manipulation capabilities, so do not allow those unless you specifically choose to do so.
- Insist that cell phones and other like devices are not allowed.
- Create a plan in advance to handle technology issues and makeup tests. These will inevitably arise.

## Math Lectures: An Oxymoron?

by Carol A. Twigg

One of the most enjoyable parts of our work at the National Center for Academic Transformation is that we learn new things all the time. There's nothing like spending most of your time engaging institutions of higher education in changing the way they think about teaching and learning to produce new ways of thinking.

Based on eight years of experience in working with a large number of colleges and universities as they seek to improve student learning while reducing instructional costs, we have identified a number of "models" and "principles" to guide the redesign of large-enrollment courses. We have learned that each of our [Five Models for Course Redesign](#) can produce improved student learning and reduced instructional costs if it embodies our [Five Principles of Successful Course Redesign](#). Therefore, as part of the application process to both our national and state redesign programs, we have heretofore asked teams to select a redesign model and explain how they will embody the Five Principles within it as the first step in the planning process.

We haven't wanted to prescribe a model for several reasons. First, we want each redesign team to "own" their redesign plan by making their own choices as they go through the planning process. Second, we are really interested in seeing variations on previous redesigns in different disciplines. We'd love to see the Emporium Model in fields other than math—a writing emporium, a chemistry emporium—or the Buffet Model in fields other than statistics. (We've seen the latter happen at Chattanooga State Technical and Community College where the psychology redesign team evolved their way from a Replacement Model into a Buffet Model, and we think this can happen in many other disciplines as well.) Third, we are also interested in seeing new models emerge as we work with greater numbers of institutions and greater numbers of disciplines.

But we have also learned that certain models seem to be appropriate to certain disciplines. For example, all of the foreign language projects that we have worked with have chosen the Replacement Model in which they move grammar instruction, practice exercises, testing, writing, and small-group activities to the online environment and use in-class time for developing and practicing oral communication skills. The nature of the discipline informs the choice of model. The Replacement Model has also been the model of choice in English composition for similar reasons.

In mathematics, the Emporium Model has consistently produced spectacular gains in student learning and impressive reductions in instructional costs. The Universities of Alabama and Idaho, LSU, Ole Miss, the University of Missouri-St. Louis, Virginia Tech and Wayne State have all replaced class meetings with a learning resource center that features student use of instructional software supported by on-demand personalized assistance. We more or less assumed that subsequent new projects in mathematics would want to emulate this success. Boy, were we wrong!

NCAT has now interacted with more than 50 institutions in their efforts to redesign introductory or developmental mathematics as part of formal course redesign programs. The majority of these institutions have initially chosen the Supplemental Model or the Replacement Model rather than the Emporium Model.

All of these institutions begin in more or less the same place. In the traditional format, the course meets three hours per week for 15 weeks and is taught in a didactic lecture format. Students often have access to a math help lab or tutoring center if they choose to take advantage of it. The course is taught by a combination of full-time faculty, temporary lecturers, adjunct faculty and graduate teaching assistants, depending on the institution. The department may choose textbooks or develop course outlines and

content standards for the course, but typically there are no consistent efforts to ensure uniformity of content presentation or assessment across all sections. The result is unacceptably high failure rates and lack of student progress toward a degree.

Introductory math courses, including many that satisfy the general education requirements, are often problematic for several reasons. Many students are simply not interested in the subject. Others may lack adequate preparation. Still others may fear failure based on negative experiences in math classes in high school. The problem is magnified when course concepts, which students have already encountered in their high school coursework, are re-taught to them using the same instructional methods that did not work the first time.

Yet what do most institutions initially propose? Some propose to retain three hours of class per week supplemented by computer-based homework (the Supplemental Model). Others propose to replace one hour of class per week with one or two hours of lab work using instructional software while retaining two hours of class in the traditional format. All too often, this is what we hear: "Over the past year and a half, the math faculty have spent much time researching best practices in developmental math. They have examined such topics as assessment, reading in the math classroom, math tutoring labs, active learning strategies and technology. Results of this research were shared and, as a group, the faculty decided to maintain the current three hours of lecture and to supplement classroom instruction with lab time." Didn't Albert Einstein define insanity as doing the same thing over and over and expecting different results?

Does keeping lectures in a math course make sense? The opinion of all of the successful faculty project leaders who have redesigned math is unanimous: students do not learn math from going to lectures. The reason most success rates in math are so low, we believe, is because the three-lectures-per-week approach is simply not appropriate for introductory mathematics courses. Retaining two of the three lectures does not substantively change the model. Consequently, we do not believe that institutions taking this approach will be able to increase student learning.

### **Why Is the Emporium Model So Successful?**

As the redesign team at Kingwood Community College in Texas has correctly observed, "The primary reason many students do not succeed in the [traditional math] course 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." This may seem obvious, but we can assure you that it is not.

The Emporium Model has been so successful for basically three reasons:

- Students spend the bulk of their course time doing math problems.

By using an instructional software package such as MyMathLab, ALEKS or Hawkes Learning Systems, students are able to spend more time on task than when they simply watch or listen to a lecture given by someone else. Students find the software easy to use and achieve a comfort level with the technology in a short amount of time. Students especially like the instant feedback they receive when working problems and the guided solutions that are available when they do not get a correct answer. The software has been evolving and improving over the last five years, providing more reliable scoring and a better interface for students and instructors.

Attending lectures are a waste of student time and energy. The three hours spent listening to lectures are three hours that could be spent doing math. As one math professor has put it so well, "Students learn math by doing math, not by listening to someone talk about doing math."

- Students spend more time on things they don't understand and less time on things they have already mastered.

The traditional lecture format treats students as “one size fits all.” Some students are bored because other students’ questions result in repetition of conceptual material they have already mastered, while other students feel overwhelmed by the amount of material covered in one lecture session. In contrast, instructional software packages-- which include interactive tutorials, computational exercises, videos, practice exercises and online quizzes--can support auditory, visual and discovery-based learning styles.

Through diagnostic assessments for each student, areas of needed practice can be highlighted and individualized study plans developed. When a student understands the material, he or she can move quickly through it and demonstrate mastery. When a student gets stuck, he or she can ask for an example or a step-by-step explanation and take more time to practice.

- Students get assistance when they encounter problems in doing math.

Traditional models increase the likelihood that students will get discouraged and stop doing the work because they must work without immediate support and admit before fellow students at the next class what they do not understand. Since most students would rather remain invisible than interact with the instructor in a public way, and will always protect themselves from embarrassment, they often do not resolve the questions they have. In addition, students typically turn in homework problems that are hand-graded and returned days after the students do the problems and make mistakes. By the time students see the graded homework, they are not sufficiently motivated to review their errors and correct the problem.

The Emporium Model provides help to students in a variety of ways. Students get help from the software’s online tutorials and guided solutions. Instant feedback lets students review their errors at the time they make them. Students also get help from fellow students. In several of the math emporia, computer stations are arranged in pods of four to six to encourage student collaboration. Students can also find help in the emporium where instructors, graduate teaching assistants and/or peer tutors are available to provide individual assistance when students encounter difficult concepts. Any problem areas that students encounter are addressed on an individual basis during lab time.

### **Overcoming the Most Common Objections to Using the Emporium Model**

We find it hard to understand why faculty teams concerned about high failure rates in math would not embrace the Emporium Model. The logic of why it works seems impeccable.

Some of the objections are logistical:

- *We can’t afford to construct and equip an emporium.* By redesigning the entire course using the Emporium Model, institutions have been able to produce substantial savings in annual operating costs, a portion of which can be re-directed to construct (which typically involves re-habbing existing space) and equip computer labs. Each of these universities produced the following annual savings by redesigning one course: LSU, \$210,700; the University of Alabama, \$60,000; Virginia Tech, \$140,000; and Wayne State, \$159,812. The University of Idaho produced an annual savings of \$101,976 by redesigning three courses.
- *Our lab size limits our ability to use the Emporium Model.* Some institutions say that their decision not to do an emporium stems from limits in the size of their lab. One applicant, for example, cites having only 85 workstations for 1500 students as an obstacle. The University of Idaho has been able to serve 2400+ students in a lab with 71 workstations in pods of four that are designed for as many as three students to work together at a single monitor. To accommodate this large number of students, the team has spread the load of student use more evenly by spreading assignment deadline dates across each day of the week. Thus 20% of students have deadline dates for assignments, tests and quizzes on Monday, 20% on Tuesday, and so on. The space is used

more consistently, rather than just before a test or assignment is due, allowing more students to be accommodated in a smaller lab and reducing the lab downtime.

Other objections are a result of misunderstanding what the Emporium Model is. There is some tendency to confuse technology-enhanced learning such as online tutorials, homework, and quizzes with self-paced online courses in which students proceed at their own pace. We have all found that leaving students out on their own doing computer homework, without having some kind of face-to-face tutoring support available, is a recipe for disaster. Students need sufficient structure within a well-articulated set of specified requirements. A laissez faire, unstructured, open-entry/open exit model simply does not work.

For some faculty, getting rid of classroom meetings implies abandoning the human interaction side of a classroom and conjures up images of students working alone. Nothing could be further from what happens in a well-designed math emporium. As noted above, on-demand personalized assistance is a hallmark of the Emporium Model. At Virginia Tech, this assistance is available 24\*7, and at most institutions using the Emporium Model, personal assistance is available far in excess of that offered by traditional formats.

In the overwhelming majority of cases, however, the decision to retain all or part of the lecture time stems from the reluctance of some or all of the faculty in the department to give up the traditional approach.

When this happens, we have several suggestions for those seeking to deal with faculty reluctance and move forward on a meaningful redesign.

- *Make lecture attendance optional for students.* Several of our projects have done this as part of the transition from the traditional format to the fully redesigned format. The faculty will have the opportunity to see whether students want or need to go to lectures.
- *Offer different kinds of sections and compare the results.* The idea here is to offer some sections with lectures and some sections without (or some with required lectures, some with optional lectures and some without) and then compare the learning results. In this way, disagreements among faculty can be settled based on empirical data.
- *Redesign what goes on in class.* Keeping one class meeting per week and redesigning (rather than retaining) the activities that occur in that meeting is a successful strategy. Both the Universities of Alabama and Idaho have one weekly group meeting. Its purpose is to review past and future assignments, troubleshoot problems (technical or mathematical) that students are having with the course, and keep students on track to complete the course.

Of course, one of the best ways to overcome faculty resistance is to have a conversation with the faculty members who have led the effort to establish a math emporium on their campuses to learn more about what they did, how they did it and why they made particular choices. We especially recommend talking to or visiting the project leaders at LSU; the Universities of Alabama, Idaho and Missouri-St. Louis; Virginia Tech or Wayne State. Each has data to support the fact that students learn math by doing math, not by listening to someone talk about doing math. It's really pretty simple, isn't it?

## **DEVELOPMENTAL COURSES: AN OXYMORON?**

by  
**Carol A. Twigg**

The Tennessee Board of Regents (TBR) has launched a Developmental Studies Redesign Initiative to reform its remedial and developmental math and English curriculum. The 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.

A 2005 TBR study revealed that level of academic preparation continues to be a major barrier to successful matriculation among first-time freshmen, regardless of age at time of entry, in Tennessee's public universities and community colleges. A large percentage of recent high school graduates fail to meet college readiness assessments. In fall 2005, 74% of recent high school graduates enrolled at TBR two-year institutions were required to take a remedial or developmental studies course. At TBR four-year universities, the level of remedial and developmental requirement was over 40%. In addition, 50% of non-traditional aged students returning to education after long periods away from the classroom are required to take remedial or developmental courses.

In the TBR system, approximately \$25 million is spent on remedial and developmental instruction annually, the cost of which is split 50/50 between state appropriations and student tuition revenues. Those tuition costs can add quickly to students' overall debt. In addition, none of the tuition payments and classroom effort results in credit toward a degree.

Students lacking the skills required to enroll in college-level courses face significant challenges persisting to a degree. Completing a series of non-credit courses to overcome deficiencies involves significant time and money for students, slowing academic progress, and sometimes derailing the momentum that comes with initial enrollment in postsecondary education. Reductions of overall costs and time to completion is a primary goal of the initiative, which will represent future permanent cost savings to students and to institutions.

During the course of this three-year project, the TBR will partner with NCAT to aggressively redesign the remedial and developmental curriculum, teaching and learning methods, and assessment strategies. Building on the successful models and lessons learned from NCAT's Program in Course Redesign, this project will develop new delivery structures that streamline course delivery, leverage new learning technologies, increase the quality of learning and reduce the cost of developmental education.

### **The Need to Redesign**

Currently, the TBR operates a remedial and developmental studies program that dates back to the early 1980's, comprised of seven courses taught primarily in traditional classroom settings in a 16-week format. The TBR program exhibits many positive qualities that other states could emulate. It uses a uniform placement testing system and offers the same seven courses (remedial and developmental) at all of its 13 community colleges and the same four of those courses (developmental only) at its six universities, helping to ensure a consistent experience for all TBR students regardless of location.

That being said, the TBR's program is not meeting the needs of its students who are quite diverse in levels of preparation, learning styles, and specific educational goals.

The current delivery strategy for courses offers a gradation of "basic remedial," "basic developmental," and "intermediate developmental" and does not afford an opportunity for students to quickly get up to performance level in one stage so that they can move to the next stage sooner. Students are required to take an entire course even though they may only be deficient in a portion of the topics. Restated, even if someone is marginally below the standard for freshman-level College Algebra, they are still placed into a 16-week course in Intermediate Developmental Algebra that requires them to sit through the full course to satisfy one or two limited or missing competencies.

The developmental course structure can present a significant obstacle to students' ability to realize their educational goals. Many students who begin a developmental course withdraw due to work, family or health issues. Students who withdraw and return the following semester must begin the same course from the beginning, even though they may have demonstrated mastery of some portion of the material prior to their withdrawal. Weaker students may be required to complete up to three full semesters of coursework prior to advancing into regular college-level courses. Many students are delayed in applying for admission to specific academic and professional programs. Others give up and drop out completely. Typical drop-failure-withdrawal rates in these courses of 40% to 50% further compound the problem.

In addition, TBR students are placed into remedial and developmental courses based on ACT or COMPASS test scores. Frequently, students are placed in a course that is beyond their skill level, and consequently, they are unable to complete the course successfully. Instructors often intervene early in the term and recommend moving to a lower level course. Since students are not required to move back once they are placed, however, they rarely choose to do so. Clearly, one important goal of redesign is to offer a more accurate placement system and thereby reduce the problems that arise with improper placement.

Finally, the current course structure standardizes the student learning experience as if all students' learning needs, interests, and abilities were the same. All students are required to learn at the same pace and with the same instructional strategies as the entire class. Because learning occurs in specific increments--especially in these skills-based courses-- and the time required to master each increment varies from person to person, the current system lacks the flexibility that could lead to greater student success.

Tennessee is not alone in dealing with these issues. Every state in the country faces similar problems in the ways in which remedial and developmental education is organized. By thinking more creatively about how to respond to a variety of learning abilities and preferences, it is possible to design structures and activities that work well with diverse types of students and lead to better, more cost-effective learning for all.

### **Modularization: A Key Strategy**

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.

In December 2006, the TBR issued a Call to Participate in the Developmental Studies Redesign Initiative to its six universities and thirteen community colleges. Specifically, campuses were invited to redesign a remedial and/or developmental course sequence in mathematics, reading,

writing or English (combined reading and writing.) With support from the Fund for the Improvement of Postsecondary Education (FIPSE), the initiative was able to award a total of \$240,000 in grants to participating institutions to support their redesign efforts. Twenty-seven proposals were submitted in July 2007, and six projects were ultimately funded. NCAT collaborated with the TBR throughout the planning and selection process.

What were we looking for in a successful redesign proposal? In addition to describing a solid plan to improve learning and reduce costs by implementing NCAT's Five Principles for Successful Course Redesign, the TBR proposals needed to include a plan to modularize the remedial and developmental course sequences. Specifically, we wanted each institution to develop a plan to:

- Customize the learning environment for each student based on background, skill level, learning preference and academic/professional goals;
- Create a learning environment that allows students and faculty to focus on the skills that students are lacking, to study only topics in which they are unprepared, and to receive remediation assistance only in the areas where they have deficiencies;
- Remove skills overlap that may be present among courses in the current structure to streamline the curriculum;
- Create diagnostic assessments that evaluate specific skills linked to content modules to ensure that students only take the modules in which they have skill deficiencies;
- Allow students to start anywhere in the 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; and,
- Permit students to earn variable credit based on how many modules they successfully complete during a term.

Most of the proposals we received struggled with the concept of modularization. No one had trouble dividing the course content into modules—after all, that's like chapters in a textbook. Almost all recognized that today's high-quality instructional software is itself modularized. But most planned to have students continue to meet in small groups in traditional classroom settings, and most planned to have "teacher-led" activities dominate the redesign. They could conceptualize how to modularize course content but not how to modularize the student experience.

There is a contradiction between individualizing the student experience (i.e., diagnosing individual students' strengths and weaknesses and creating individual paths for them to correct their deficiencies) and meeting in traditional classes in which students are grouped together primarily for scheduling reasons. Student progress through the course materials will vary considerably. One-third may be in the middle of the material in any given class, one-third may have already accomplished the goals of today's class, and one-third may be lagging behind. Some students may be bored because other students' questions result in repetition of conceptual material they have already mastered, while other students feel overwhelmed by the amount of material covered in one class. It's not that meeting in groups is a bad thing to do. But a successful TBR redesign proposal needed to reconcile modularization and group meetings in new and innovative ways.

In contrast, six of the TBR institutions have developed innovative plans to individualize the student experience (i.e., diagnosing individual students' strengths and weaknesses and creating individual paths for them to correct their deficiencies) and allow them to progress through the course content at variable rates: **Austin Peay State University, Chattanooga State Technical Community College, Cleveland State Community College, Columbia State Community College, Jackson State Community College and Northeast State Technical Community College**. Each represents a unique approach to redesigning remedial and developmental courses.

Since NCAT is working closely with the TBR to ensure that improvements in student learning outcomes and reductions in instructional costs are carefully measured and documented, this project should go a long way in discovering the most effective and efficient ways to make a real difference in this critical area of educational need and to provide models that the rest of the country can emulate.

Let's take a look at the role of modularization in each of the six project plans.

Not surprisingly, the Emporium Model pioneered at Virginia Tech and replicated at many additional institutions is ideally suited to the goals of the TBR initiative, and **Cleveland State Community College** plans to redesign three math courses (Basic Math, Elementary Algebra and Intermediate Algebra) using that model. Drop-failure-withdrawal (DFW) rates in these courses currently average 45%. Cleveland State will use either *MyMathLab* or *MathZone* instructional software. Students will meet one hour in class and two hours in a large computer lab. The one-hour class meetings will be held in small labs (20 computers). Instructors will not lecture; students will work online and instructors will help students individually. Instructors will also review student progress and help students with their action plans for the coming week. The large computer lab will be available 54 hours per week to allow students to work at their convenience. The lab will be staffed by instructors and peer tutors to provide assistance to the students. Course material will be organized into 10 to 12 modules, which students will complete at the rate of one or more each week. All homework and testing will be done online. Quizzes on each module can be re-taken multiple times until students display mastery. Students will 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 will be allowed to begin the next developmental course immediately.

We were not surprised to see Cleveland State choose the Emporium Model for a math redesign, but we were very pleased to see the same model chosen for a reading redesign! **Northeast State Technical Community College** will move away from the traditional course delivery of small sections to a learner-centered, active learning mode supported by interactive, modularized learning software in its redesign of Basic and Developmental Reading. One large section of all enrolled students will replace traditional small sections (~17 students), which typically experience DFW rates ranging from 34% to 45%. Students will be required to spend three hours weekly in a reading center open 35 - 45 hours per week where they will have access to high-quality web-based interactive learning materials and resources and individualized face-to-face assistance. Students will also have access to web-based online learning materials 24/7 from anywhere they choose. *Tegrity* software will be utilized to provide students with pre-recorded lectures and discussions of key course concepts. Students will also be required to carry out collaborative learning activities by joining an online learning community and completing weekly online discussion and reflection on the course content.

Northeast will reorganize the two reading courses into 16 modules using *MyReadingLab*. Each module will have clearly defined learning objectives, tutorials, practice exercises, assessments for mastery and built-in deadline. Students will initially take a diagnostic test on their reading skills and their reading levels to ascertain their reading capability. Based on the diagnostic results, students will receive a personalized study plan that contains the modules necessary to gain the reading skills they lack and to improve their reading levels. Students may exit a course at any time when they pass the module tests and a comprehensive course post-test. Early exit will allow students to spend additional time on other courses they are taking and also increase their confidence as successful learners. Remediation will be provided to those who fall behind the learning schedule, and corrective actions will be taken by instructors to keep students on track so that they can finish course within the semester.

The team at **Austin Peay State University (APSU)** has developed a very innovative idea to redesign two developmental math courses where approximately one-half of the students either

fail or withdraw. Their redesign will eliminate developmental courses entirely! Students whose placement tests indicate developmental needs will enroll in the core math course required for their major—either Foundations of Mathematics or Elements of Statistics—and will receive supplemental academic support on a just-in-time basis to remove the deficiencies in mathematical competencies required for success in the core course. The redesign model selected by APSU is based on the Structured Learning Assistance (SLA) model developed by Ferris State University in Michigan. The core courses will not change in content but will be linked to SLA workshops consisting of computer-based instruction (*MyMathLab*), small-group activities and test reviews to provide additional instruction on key mathematical concepts within the courses. The statistics workshops will also use *Fathom* and *Minitab* in addition to *MyMathLab*. SLA workshops will be facilitated by students who have excelled in math and have been recommended by math faculty.

During the initial meeting of the workshop, students will be assessed to determine their specific math deficiencies. APSU's math faculty have collectively determined the prerequisite competencies that are required in order for students to successfully complete each of the two core math courses involved in the course redesign. Only the deficiencies which are deemed necessary for success in the core mathematics course will be addressed during the workshops. Students will be individually assigned modules within *MyMathLab* based on the results of the assessment. Students will complete the modules on a just-in-time basis so that they are prepared to use the associated mathematics skills as the core course requires. In addition, the workshop leader will review the more difficult concepts that were covered during class instruction. Just-in-time instruction on prerequisite competencies is designed so that students will use the concepts during the following class session, which in turn will help them see the value of the workshops and motivate them to do the exercises.

**Jackson State Community College** plans to combine parts of the approaches used by Cleveland State and APSU. The course redesign will use the Emporium Model, creating a learning center where students will work with *MyMathLab* and receive immediate assistance from instructors and tutors. Jackson State will re-organize the three developmental math courses, which currently face a failure rate of ~44%, into a single course organized in nine modules. But somewhat like APSU's just-in-time approach, students will be required to master only those concepts needed for their career goals which have been identified as deficiencies. Jackson State will survey all career programs on campus to determine which modules their students will be required to complete prior to admission. Pre-requisite competencies for general-education mathematics courses will be reviewed to determine pre-requisite modules.

A pre-test on an established set of competencies will determine what concepts students will be required to master for their majors. Following this assessment, each student will receive an individualized learning contract detailing a list of those modules that need to be mastered. The contract will also include a schedule for completion of each module which will provide a path to achieving the desired learning outcomes. Student learning will be accommodated by online tutorials, video lectures, instructor-led lecture/discussion groups, organized group study, one-on-one tutoring, and other activities housed in a learning center. The center will offer remediation for students who fall behind in scheduled work and acceleration for students who are capable of moving through the modules more quickly. The redesign will create an enhanced developmental math program that will prepare students for their own educational goals whether they involve beginning a program of study in a field that requires advanced mathematics, completing a general education mathematics course, or applying for admission to Jackson State's nursing or allied health programs.

**Chattanooga State Technical Community College (CSTCC)** plans to redesign its three developmental math courses which serve ~3600 students annually. These courses experience low student success rates (excluding withdrawals) ranging from 51% to 64%. Most students are currently taught in a traditional lecture format with one instructor teaching up to 28 students in a

class supplemented with computer-based homework using *MyMathLab*. Students also have the option of working in a lab setting to complete all homework. Recognizing from past experience that using *MyMathLab* as a supplement rather than as the focus of the course and having learned that “freshmen don’t do optional,” CSTCC will standardize content and assessment across all sections and require students to work in the lab. Students will spend two hours in class and two hours in a computer lab each week. The computer lab will be open ~65 hours per week, staffed by professional tutors, faculty and student tutors. Students in this active learning environment will be able to progress at their own rate, receiving immediate feedback from the software and one-on-one assistance. They will also be encouraged to work collaboratively on the homework.

The college’s redesign plan will modularize the course. On the first day of class, a challenge test will be administered to each student in order to determine module placement. If a student successfully completes a challenge test (80% or higher), he or she will be given credit for that module and will proceed to the next module in the sequence. Students will move from one module to the next (called “module promotion”) by achieving a 75% or higher score on that module post-test. If a module post-test is not passed on the first attempt, the student will repeat the module. Students may continue on in the modules from the subsequent course. When students begin the next semester, they will either continue in the module that was not completed or take the next challenge test for module placement. The module approach will support various learning styles and eliminate the conflict of mastering multiple topics simultaneously.

At CSTCC’s main Amnicola campus, students will be placed into large sections of ~90, up to a maximum of 110 students. The sections will be team-taught by three instructors. Two will hold large class lectures for students who are progressing in a standard sequence. The third instructor will teach two module sections, one for students who are ahead of the standard sequence and one for students who are falling behind. At CSTCC’s satellite campuses, a similar two-plus-two arrangement will be used, but one instructor will teach up to two modules.

Finally, **Columbia State Community College (CSCC)** will use a phased approach in its plan to redesign its developmental writing and reading programs, which comprise four three-hour courses, all of which suffer from poor retention with DFW rates of more than 50% in some semesters. During the initial phase of the CSCC redesign plan in spring 2008, two reading courses will be compressed into a single three-credit course, and two writing courses will also be compressed into a single three-credit course. Instructional software (*MyWritingLab* and *MyReadingLab*) will provide students with skills-based learning tools, allowing for a more standard use of class time across sections that focuses on hands-on reading and writing practice. This pilot period will provide instructors the essential opportunity to analyze the strengths and weaknesses of the new software and allow them to work with students operating at a variety of proficiency levels in a single classroom setting.

During the second phase in fall 2008 semester, the reading course will be divided into three one-hour modules (Vocabulary, Comprehension and Advanced Comprehension). The writing course will be divided into four one-hour modules (Punctuation and Mechanics, Grammar and Usage, Paragraph Writing, and Introduction to Essay Writing). Each one-hour module will be taught in five weeks. Students will only assemble as a group for one 80-minute class period per week for lecture and practice of areas identified by the instructors during the first phase. The hybrid modules will be managed through Online Campus (Desire to Learn), where students will have links into their required software materials, assignments, grades, calendar and communication tools. Since the Paragraph and Essay modules will require significant grading time for instructors, they will be facilitated in smaller groups of 20. The Punctuation and Mechanics and Grammar and Usage modules will be driven primarily by the software and graded likewise, allowing for a class size of 40.

All students who enroll at CSCC with a reading or writing requirement will take a COMPASS test for the discipline in which they have placed, which will determine the modules required for each

student. Students will be required to demonstrate a 75% proficiency to earn credit for completion of a module. Flexible scheduling will provide students an opportunity to complete all their reading and writing requirements within one semester and will also provide them with an opportunity to repeat unsuccessful modules.

### **Learning from Experience**

Just about all of these institutions have had some kind of prior experience in using instructional software in remedial and developmental courses in an effort to improve success rates, but they have not experienced a significant increase in student success. They have learned some valuable lessons from those experiences that correlate with the experiences of successful NCAT projects, which include the importance of

- Coordinating faculty efforts

Rather than leaving it up to individual instructors to decide whether or not to use instructional software and how to use it, these new redesigns will coordinate the efforts of all course instructors so that all students receive a uniform, high-quality learning experience.

- Redesigning the whole course

In the past, TBR institutions have offered paired courses, combined courses, fast-track courses and online courses in remedial and developmental programs with negligible success. In many cases, these were primarily pilot projects that received limited advertising and often very small sections that provided an option, at the last minute, to those students who had registered too late for any other section. The new redesign plans will take on the whole course and make sure that the campus is well-prepared to publicize and explain the new opportunities to students.

- Using software as the focus of the course rather than as a supplement

Many past efforts used a textbook supplemented with some online tutorial software with limited usefulness. These new redesigns make software a centerpiece of their redesigns.

- Recognizing that freshmen don't do optional

Some TBR institutions have tried to alter their course delivery systems from a traditional lecture class without a technology component to a "self-paced," fully computerized course. The result was that, in some cases, success rates dropped by 20 percentage points. The new redesign efforts make student participation mandatory within a well-structured course that includes milestones for completion.

- Providing students with individualized assistance

Historically, some TBR institutions have offered these courses in a computerized classroom but with a traditional instructor-centered and lecture-based format, which unfortunately allowed very little or no individual assistance in class to accommodate the wide range of student learning needs. All of the new redesign plans include many different ways of providing students with *individualized* assistance and, in many cases, at times convenient to them on-demand as needed.

## **What about Cost?**

Remember that in addition to increasing student learning, one of the goals of the TBR initiative is to reduce the amount of time students spend in remedial and developmental courses, thereby reducing the cost to students, as well as to decrease the amount of fiscal resources that are dedicated to remedial and developmental education by the TBR. All of these redesign plans will reduce the institution's cost of providing remedial and developmental education; projections range from a 21% to a 51% reduction. Modularizing the courses allows the institutions to decrease the number of sections offered. Relying on high-quality instructional software to offload time-consuming faculty tasks like grading allows the institutions to increase section size. Fewer instructors will be required to teach remedial and developmental courses. In most cases, that means reducing the number of adjunct faculty, who are often difficult to find, and relying more heavily on full-time faculty.

## **Implications for Others**

A November 2003 NCES study revealed that nationwide, 28% of freshmen entering college in 2000 were enrolled in one or more remedial reading, writing, or mathematics courses. At public two-year institutions, 42% of freshmen enrolled in these courses and at public four-year institutions, 20% of freshmen were enrolled. That same study showed an increase in the average length of time that students spent in remedial education courses. For example, between 1995 and 2000, the proportion of institutions that reported an average of one year of remediation for students increased from 28% to 35%, while the proportion indicating an average of less than one year of remediation for students decreased from 67% to 60%. Public two-year colleges were more likely than public four-year institutions to report that students spent an average of one year or more on remedial courses.

Clearly the implications for colleges and universities around the country of the outcomes produced by the TBR initiative are substantial. By putting students first and organizing their redesigns around the individual needs of students rather than the convenience of institutions, these pioneering institutions may well make 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. We'll keep you posted on the results!

## NCAT Redesign Scholars in Mathematics

[Betty Frost](#), Jackson State Community College  
[Jamie Glass](#), The University of Alabama  
[Phoebe Rouse](#), Louisiana State University  
[John Squires](#), Chattanooga State Community College  
[Kirk Trigsted](#), University of Idaho  
[Karen Wyrick](#), Cleveland State Community College

**Scholar:** [Betty Frost](#)

**Institution:** Jackson State Community College

**Redesign Description:** [Basic Math](#), [Elementary Algebra](#), [Intermediate Algebra](#)

Betty Frost has been a member of the faculty at Jackson State Community College (JSCC) for 35 years, serving as chair of the mathematics department for over 20 of those years. She has taught math courses ranging from Basic Mathematics through Calculus III. She led the team that redesigned JSCC's remedial and developmental math sequence that annually enrolls ~2200 students. Key features of JSCC's redesign are mastery learning, modularization, multi-exit options, and the SMART Math Center, an emporium that accommodates 80 students. Even though she was a naysayer at the beginning of the redesign process, Betty has become genuinely committed to the concepts of course redesign and to helping others redesign their courses in ways that will best meet their needs and the need of their students. Betty earned an A.S. in mathematics from Northeast Mississippi Junior College; a B.A. in math education from the University of Mississippi and an M.S. in mathematics from Memphis State University.

**Scholar:** [Jamie Glass](#)

**Institution:** The University of Alabama

**Redesign Description:** [Intermediate Algebra](#)

Jamie Glass has been an instructor at The University of Alabama (UA) for 19 years and has taught all levels of freshman mathematics. Since 2001, she has managed the day-to-day operations of the Mathematics Technology Learning Center (MTLC), which serves ~9500 students per year. Jamie has been involved with course redesign since 1999 and has worked with an extraordinary group of peers to redesign all of the freshman-level math courses at UA over the last 10 years. During Jamie's tenure, the MTLC has received a 2001 Alabama Quality Award (Judges Special Recognition), a 2008 Pearson Teaching and Technology Leadership Award and a 2009 Top Honors (Platinum) Award from the IMS Global Learning Consortium. Jamie has advised numerous colleges and universities about course redesign, offering advice about operations, policies, decisions and mistakes made at UA. She also teaches AP Calculus at a local private high school. Jamie earned a B.S. in mathematics at Jacksonville State University and an M.A. in math education at The University of Alabama at Birmingham.

**Scholar:** [Phoebe Rouse](#)

**Institution:** Louisiana State University

**Redesign Description:** [College Algebra](#)

Phoebe Rouse has been an instructor at LSU for 29 years and has taught college algebra, trigonometry, math for pre-service teachers, liberal arts math, business calculus, and teacher-training courses for graduate students. She has been the College Algebra Course Coordinator for 15 years and has received four university excellence in teaching awards. In fall 2003, Phoebe led the redesign of LSU's college algebra course as part of NCAT's Roadmap to Redesign program, which included constructing learning lab space for 275 students. As the Precalculus Mathematics Coordinator for the last six years, she has

expanded the LSU redesign program to include 5,000 students in three courses using entirely computer-based assessments. She has contributed material to four successful textbook series, videotaped a commercial business calculus lecture series and written content for *MyMathLab/MathXL* software. Over the last six years, she has guided many other colleges, universities and high schools in their use of technology to redesign their courses in ways that will best meet their needs and the need of their students. Phoebe earned a B.S. in math education with a minor in speech and an M.Ed. with an emphasis in supervision and administration, both at LSU.

**Scholar:** [John Squires](#)

**Institution:** Chattanooga State Community College

**Redesign Description:** [Basic Math, Elementary Algebra, Intermediate Algebra](#) (at Cleveland State Community College)

John Squires currently serves as the math department chair at Chattanooga State Community College. Prior to that, he taught math at Cleveland State Community College for 19 years and chaired the math department from 1999 to 2009. At Cleveland State, he received the 2007 Faculty Star Award for outstanding service to the institution and the 2008 Distinguished Faculty Award. John was the architect of the redesign of developmental and college-level math at Cleveland State, which won the 2009 Bellwether Award given annually by the Community College Futures Assembly. He is currently implementing course redesign throughout the entire math curriculum at Chattanooga State. John is the recipient of the League for Innovation's 2009-2010 Cross Fellowship. John has a B.S. in economics from Iowa State University, an M.A.T. in mathematics from Drake University and an M.S. in mathematics from the University of Tennessee.

**Scholar:** [Kirk Trigsted](#)

**Institution:** University of Idaho

**Redesign Description:** [Pre-Calculus](#)

Kirk Trigsted has been a faculty member in the math department at the University of Idaho since 1996 and the Director of the Polya Mathematics Learning Center since 2001. The Polya Mathematics Learning Center was created in 2001 as part of NCAT's Program in Course Redesign and began with the redesign of two large-enrollment introductory math courses, Intermediate Algebra and College Algebra. Kirk oversees a staff of 50 employees including instructors, graduate students and undergraduate students. Kirk has worked with NCAT's Roadmap to Redesign program to enable new colleges and universities to adopt mathematics redesigns. Kirk received a B.S. in Mathematics and Education from Lewis-Clark State College in 1991 and taught high school in Texas and Idaho for three years. He also received an M.S. in mathematics from the University of Idaho in 1996.

**Scholar:** [Karen Wyrick](#)

**Institution:** Cleveland State Community College

**Redesign Description:** [Basic Math, Elementary Algebra, Intermediate Algebra](#)

Karen Wyrick has taught math at Cleveland State Community College since 1992. She is an outstanding instructor and has been selected by students as the college's best instructor on more than one occasion. She was the recipient of the 2006 Faculty Star Award for outstanding service to the institution. Karen is currently the math department chair at Cleveland State and has been an active participant in the successful redesign of three developmental math courses and eight college-level math courses. Karen has a B.S. and an M.S. in mathematics from Middle Tennessee State University.



## Corporate Contact Information

The National Center for Academic Transformation works closely with a number of higher education companies to ensure that educational institutions participating in cutting-edge course redesigns have knowledge of the best technology and best content to produce the best outcomes.

As project teams consider which tools to use, questions specific to a course redesign project may arise that cannot be answered by the sales representative that is assigned to your institution. If that situation arises, please refer to the contact information below for a person at each of the companies we currently work with that NCAT knows is familiar with the NCAT course redesign program and can help. In addition, teams might be contacted by these companies proactively but are under no obligation to work with them. Please note that NCAT does not endorse any particular company, software or tool but rather all tools that are proven to be effective in improving learning outcomes and reducing instructional costs.

### **Company**

### **Contact(s)**

**Carnegie Learning**  
412-690-2442

Michelle Muller  
Marketing Specialist  
[mmuller@carnegielearning.com](mailto:mmuller@carnegielearning.com)

**Cengage**  
513-229-1502

Douglas Ingersoll  
Marketing Director  
[douglas.ingersoll@cengage.com](mailto:douglas.ingersoll@cengage.com)

**Educational Testing Service**  
305-255-8347

Jon Alexiou  
Director, Community College Initiatives  
[JAlexiou@ets.org](mailto:JAlexiou@ets.org)

**Hawkes Learning**  
843-571-2825

Brittany Walker  
Marketing Coordinator  
[bwalker@hawkeslearning.com](mailto:bwalker@hawkeslearning.com)

**iLearn, Inc.**  
770-218-0972 x101

Robert L. Collins  
CEO  
[bob@ilearn.com](mailto:bob@ilearn.com)

**Pearson Education**  
617-848-7420

Karen Mullane  
VP/Director Marketing, Faculty Programs  
MyMathLab/MathXLI/MyEconLab/Mastering X  
[karen.mullane@pearson.com](mailto:karen.mullane@pearson.com)

**SIRIUS Academics**  
904-632-3307

Rick Granger  
Director, Marketing and Sales  
[lgranger@fscj.edu](mailto:lgranger@fscj.edu)

**SMARTHINKING, Inc.**  
424-206-9578

Kristin O'Bannon  
Director of Strategic Marketing  
[obannonk@smarthinking.com](mailto:obannonk@smarthinking.com)

**SunGard Higher Education**  
919-933-2543

William H. Graves  
Sr. VP for Academic Strategy  
[Bill.Graves@sungardhe.com](mailto:Bill.Graves@sungardhe.com)



## ABOUT THE NATIONAL CENTER FOR ACADEMIC TRANSFORMATION

### Who We Are

The National Center for Academic Transformation (NCAT) is an independent, not-for-profit organization that provides leadership in using information technology to redesign learning environments to produce better learning outcomes for students at a reduced cost to the institution. The NCAT staff has extensive experience in higher education as faculty members, administrators and researchers in both traditional and non-traditional higher education environments.

### What We Do

NCAT works through a four-stage iterative process to advance the use of information technology in improving student learning and reducing instructional costs:

#### 1. Proof of Concept

NCAT creates and conducts innovative programs that use technology to improve learning and reduce costs in partnership with colleges and universities. The outcome of each effort is a proof of concept. For example:

- Program in Course Redesign (PCR), funded by the Pew Charitable Trusts, 1999 – 2003
- Roadmap to Redesign (R2R), funded by FIPSE, 2003 – 2006
- Colleagues Committed to Redesign (C2R), funded by FIPSE, 2006 – 2009

#### 2. Analysis

NCAT analyzes the results of these programs to identify and document specific techniques and practices that lead to success, to develop models for future practice and to learn what next steps are needed to scale the proof of concept. For example:

- PCR Outcomes Analyses
- Increasing Success for Underserved Students, a Lumina-funded study
- R2R Outcomes Analyses

#### 3. Communication

NCAT communicates these lessons learned by writing and speaking for professional and general audiences about successful patterns and practices that lead to improved student learning and reduced instructional costs. For example:

- *The Learning MarketSpace*, a quarterly electronic newsletter
- Articles and Monographs, available on the NCAT web site
- The Redesign Alliance, a national membership organization

#### 4. Scale

NCAT works with institutions, systems, districts and states to scale the proof of concept to impact greater numbers of students, faculty members and institutions and achieve significant educational change. For example:

- Arizona Board of Regents (2006 – 2009)
- Tennessee Board of Regents (2006 – 2009)
- University System of Maryland (2006 – 2009)

NCAT then uses the feedback and experience gained in each stage of the process to create and conduct additional programs in partnership with colleges and universities that demonstrate new ways to achieve improved student learning and reduced instructional cost.

For more information about NCAT and its programs, see [www.theNCAT.org](http://www.theNCAT.org).

## **Bios**

**Dr. Carol A. Twigg** is President and CEO of the National Center for Academic Transformation and an internationally recognized expert in using information technology to transform teaching and learning in higher education. Winner of the McGraw Prize in Education, she is former Vice President of Educom (now EDUCAUSE), where she advanced the need for new models of student-centered, online teaching and learning, now commonly accepted in higher education. She also initiated the IMS Global Learning Consortium, which is establishing interoperable technical standards for online education and training. Before joining Educom, she was Associate Vice Chancellor for Learning Technologies for the State University of New York and held a number of senior academic administrative positions at Empire State College.

Carol holds a Ph.D. in English Literature from the State University of New York at Buffalo and Bachelor of Arts degree from the College of William and Mary.

**Carolyn Jarmon** is Vice President of the National Center for Academic Transformation. From 1996–1998, she served as the Educom Visiting Fellow, working with member institutions, including California State University System and the University of Wisconsin-Madison, redesigning learning environments to make them more cost-effective. Carolyn has given numerous presentations and been published widely on the topics of effective delivery of student services and distance education and she consults regularly with institutions and corporations about learning in distributed environments. Prior to joining NCAT, Carolyn held several academic and administrative positions at SUNY Empire State College. Carolyn has also taught and held administrative positions at several traditional institutions, both public and private.

Carolyn has a Ph.D. from Cornell University, a Master's in Business Administration from East Tennessee State University, and a Bachelor of Science degree from the University of Delaware.