IMPROVING LEARNING & REDUCING COSTS
The Program in Course Redesign
Faced with the invention of the telegraph . . .

Buy faster horses!
Get better riders!
the first motion picture that stopped filming stage plays
Technique Lags Behind Technology
TRADITIONAL INSTRUCTION

Seminars

Lectures
“BOLT-ON” INSTRUCTION
HIGHER EDUCATION’S CHALLENGES

- Access
- Quality
- Cost

How can we move the ATM’s outside the bank?
PROGRAM IN COURSE REDESIGN

To encourage colleges and universities to redesign their approaches to instruction using technology to achieve cost savings as well as quality enhancements.

$6 million
30 projects
THE ONE PERCENT SOLUTION

- Maricopa Community College District
- 200,000 students year-round
- 2,000 course titles

- 25 courses = 44% enrollment
THE ONE PERCENT SOLUTION

- English (7)
- Psychology (1)
- Mathematics (5)
- Fitness (1)
- Sociology (1)
- Computing (1)
- Philosophy (1)
- Economics (2)
- Biology (2)

- Accounting (1)
- EMT (1)
- Spanish (1)
- Chemistry (1)
ROUND I INSTITUTIONS
20,585 Students Annually

- IUPUI (Sociology)
- Penn State (Statistics)
- Rio Salado College (College Algebra)
- SUNY at Buffalo (Computer Literacy)
- U of Central Florida (American Government)
- U of Colorado-Boulder (Astronomy)
- U of Illinois-Urbana Champaign (Statistics)
- U of Southern Maine (Psychology)
- U of Wisconsin-Madison (Chemistry)
- Virginia Tech (Linear Algebra)
ROUND II INSTITUTIONS
14,119 Students Annually

- Cal Poly Pomona (Psychology)
- Carnegie Mellon University (Statistics)
- Fairfield University (Biology)
- Riverside Community College (Math)
- The University of Alabama (Math)
- University of Dayton (Psychology)
- University of Idaho (Math)
- The University of Iowa (Chemistry)
- University of Massachusetts (Biology)
- University of Tennessee (Spanish)
ROUND III INSTITUTIONS
18,734 Students Annually

- Brigham Young U (English Composition)
- Drexel U (Computer Programming)
- Florida Gulf Coast U (Fine Arts)
- Iowa State U (Discrete Math)
- Northern Arizona U (College Algebra)
- Ohio State U (Statistics)
- Portland State U (Introductory Spanish)
- Tallahassee CC (English Comp)
- U of New Mexico (Intro Psychology)
- U of Southern Mississippi (World Lit)
QUANTITATIVE (13)

- Mathematics
  - Iowa State University
  - Northern Arizona University
  - Rio Salado College
  - Riverside CC
  - University of Alabama
  - University of Idaho
  - Virginia Tech

- Statistics
  - Carnegie Mellon University
  - Ohio State University
  - Penn State
  - U of Illinois-Urbana Champaign

- Computer Programming
  - Drexel University
  - University at Buffalo
SCIENCES (5)
SOCIAL SCIENCES (6)

- Biology
  - Fairfield University
  - University of Massachusetts

- Chemistry
  - University of Iowa
  - U of Wisconsin-Madison

- Astronomy
  - U of Colorado-Boulder

- Psychology
  - Cal Poly Pomona
  - University of Dayton
  - University of New Mexico
  - U of Southern Maine

- Sociology
  - IUPUI

- American Government
  - U of Central Florida
HUMANITIES (6)

- English Composition
  - Brigham Young University
  - Tallahassee CC

- Spanish
  - Portland State University
  - University of Tennessee

- Fine Arts
  - Florida Gulf Coast University

- World Literature
  - University of Southern Mississippi
REDESIGN CHARACTERISTICS

- Redesign the whole course, not just a single class
- Emphasize active learning; greater student engagement with the material and with one another
- Rely heavily on interactive software used independently and in teams
- Provide on-demand, individualized assistance
- Provide 24 x 7 access to online learning resources

Improving the Quality of Student Learning
REDESIGN CHARACTERISTICS

- Emphasize practice, feedback, reinforcement
- Respond to differences in learning style
- Use course management software to monitor student performance
- Automate grading of homework, quizzes, exams
- Replace single mode instruction with differentiated personnel strategies

Technology enables good pedagogy with large #s of students.
IMPROVED LEARNING OUTCOMES

- Penn State - 68% on a content-knowledge test vs. 60%
- UB - 56% earned A- or higher vs. 37%
- CMU - scores on skill/concept tests increased by 22.8%
- Fairfield – 88% on concept retention vs. 79%
- U of Idaho – 30% earned A’s vs. 20%
- UMass – 73% on tougher exams vs. 61%
- FGCU - 85% on exams vs. 70%; 75% A’s and B’s vs. 31%
- USM - scored a full point higher on writing assessments
- IUPUI, RCC, UCF, U of S Maine, U of Tenn and U of Ala - significant improvements in understanding content

5 of 10 (Round I), 9 of 10 (Round II), 8 of 10 (Round III) have shown improvement.
REDUCTION IN DFW RATES

- FGCU - 45% to 11%
- UNM - 42% to 18%
- Drexel - 49% to 38%
- Iowa State - 32.5% to 23.8%
- IUPUI - 39% to 25%
- U of S Maine - 28% to 19%
- Ohio State - 33% to 24%
- Penn State - 12% to 9.8%

22 of the 24 that measured have shown improvement.
VARIETY OF WAYS TO REDUCE COSTS (Variety of Instructional Models)

- Maintain constant enrollment while reducing resources
- Increase enrollments while maintaining resources
- Reduce course repetitions
- Do two or more simultaneously
Instructional Task Analysis & Financial Planning

- Determine all personnel costs expressed as an hourly rate.
- Determine the specific tasks associated with offering a course.
- Determine how much time each person spends on each of the tasks.
- Calculate the total instructional costs.
- Redesign the course by task and re-calculate the costs.
# Instructional Costs per Hour

<table>
<thead>
<tr>
<th>Faculty</th>
<th>TAs/GAs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Salary</strong></td>
<td>$89,538</td>
</tr>
<tr>
<td>% devoted to instruction</td>
<td>50%</td>
</tr>
<tr>
<td>% devoted to this course</td>
<td>50%</td>
</tr>
<tr>
<td>$ devoted to this course</td>
<td>$22,385</td>
</tr>
<tr>
<td>Contact hours for course</td>
<td>30</td>
</tr>
<tr>
<td>Out of class hours</td>
<td>140</td>
</tr>
<tr>
<td>Total hours</td>
<td>170</td>
</tr>
<tr>
<td>Cost per hour</td>
<td>$132</td>
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</table>

## Support Staff $ per Hour

<table>
<thead>
<tr>
<th>Position</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>$19</td>
<td>$29</td>
<td>$12</td>
<td>$7</td>
</tr>
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</table>
## Traditional Course Preparation

<table>
<thead>
<tr>
<th>FACULTY</th>
<th>TAs/GAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly rate = $132</td>
<td>Hourly rate = $23</td>
</tr>
</tbody>
</table>

### I. Course Preparation

<table>
<thead>
<tr>
<th></th>
<th># of Hours</th>
<th>Total Cost</th>
<th># of Hours</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Curriculum Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Materials Acquisition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Materials Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Lectures/presentations</td>
<td>60</td>
<td>$7,900</td>
<td>464</td>
<td>$10,510</td>
</tr>
<tr>
<td>2. Learning materials/software</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Diagnostic assessments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Assignments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Tests/evaluations</td>
<td>12</td>
<td>$1,580</td>
<td>88</td>
<td>$1,993</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>72</td>
<td>$9,480</td>
<td>552</td>
<td>$12,503</td>
</tr>
<tr>
<td>D. Faculty/TA Devmt/Training</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Orientation</td>
<td>240</td>
<td></td>
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<td>$5,436</td>
</tr>
<tr>
<td>2. Staff meetings</td>
<td>15</td>
<td>$1,975</td>
<td>120</td>
<td>$2,718</td>
</tr>
<tr>
<td>3. Attend lectures</td>
<td>240</td>
<td></td>
<td></td>
<td>$5,436</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>15</td>
<td>$1,975</td>
<td>600</td>
<td>$13,590</td>
</tr>
<tr>
<td>Total Preparation</td>
<td>87</td>
<td>$11,455</td>
<td>1152</td>
<td>$26,093</td>
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Traditional Course Delivery

<table>
<thead>
<tr>
<th>Course Delivery</th>
<th># of Hours</th>
<th>Total Cost</th>
<th># of Hours</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Instruction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Diagnose skill/knowledge level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Presentation</td>
<td>30</td>
<td>$3,950</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Interaction</td>
<td>30</td>
<td>$3,950</td>
<td>1048</td>
<td>$23,737</td>
</tr>
<tr>
<td>4. Progress monitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Total</td>
<td>60</td>
<td>$7,900</td>
<td>1048</td>
<td>$23,737</td>
</tr>
<tr>
<td><strong>B. Evaluation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Test proctoring</td>
<td>11</td>
<td>$1,448</td>
<td>32</td>
<td>$725</td>
</tr>
<tr>
<td>2. Tests/evaluation</td>
<td>12</td>
<td>$1,580</td>
<td>648</td>
<td>$14,677</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>23</td>
<td>$3,028</td>
<td>680</td>
<td>$15,402</td>
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<tr>
<td>Total Delivery</td>
<td>83</td>
<td>$10,929</td>
<td>1728</td>
<td>$39,139</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>170</td>
<td>$22,384</td>
<td>2880</td>
<td>$65,232</td>
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<tr>
<td>Support Staff = $3805</td>
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<tr>
<td><strong>GRAND TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>$91,421</td>
</tr>
<tr>
<td>Total # of students</td>
<td>350</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per student</td>
<td></td>
<td></td>
<td></td>
<td>$261.20</td>
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</table>
## Redesigned Course Preparation

<table>
<thead>
<tr>
<th>I. Course Preparation</th>
<th>FACULTY</th>
<th>TAs/GAs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of Hours</td>
<td>Total Cost</td>
</tr>
<tr>
<td><strong>A. Curriculum Development</strong></td>
<td>Hourly rate = $132</td>
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</tr>
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<td>4. Assignments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Tests/evaluations</td>
<td>12</td>
<td>$1,580</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td>27</td>
<td>$3,555</td>
</tr>
<tr>
<td><strong>D. Faculty/TA Devmt/Training</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Orientation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Staff meetings</td>
<td>15</td>
<td>$1,975</td>
</tr>
<tr>
<td>3. Attend lectures</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td>15</td>
<td>$1,975</td>
</tr>
<tr>
<td><strong>Total Preparation</strong></td>
<td>42</td>
<td>$5,530</td>
</tr>
</tbody>
</table>
## Redesigned Course Delivery

### II. Course Delivery

<table>
<thead>
<tr>
<th></th>
<th># of Hours</th>
<th>Total Cost</th>
<th># of Hours</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Instruction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Diagnose skill/knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Presentation</td>
<td>30</td>
<td>$3,950</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Interaction</td>
<td>30</td>
<td>$3,950</td>
<td>808</td>
<td>$18,301</td>
</tr>
<tr>
<td>4. Progress monitoring</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td>60</td>
<td>$7,900</td>
<td>808</td>
<td>$18,301</td>
</tr>
<tr>
<td><strong>B. Evaluation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Test proctoring</td>
<td>11</td>
<td>$1,448</td>
<td>32</td>
<td>$725</td>
</tr>
<tr>
<td>2. Tests/evaluation</td>
<td>12</td>
<td>$1,580</td>
<td>408</td>
<td>$9,241</td>
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<tr>
<td><strong>Sub-Total</strong></td>
<td>23</td>
<td>$3,028</td>
<td>440</td>
<td>$9,966</td>
</tr>
<tr>
<td><strong>Total Delivery</strong></td>
<td>83</td>
<td>$10,929</td>
<td>1248</td>
<td>$28,267</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>125</td>
<td>$16,459</td>
<td>2040</td>
<td>$46,206</td>
</tr>
<tr>
<td>Support Staff Carryover</td>
<td></td>
<td>$3,805</td>
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<tr>
<td>Additional Support Staff</td>
<td>480</td>
<td>$3,360</td>
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<tr>
<td><strong>Total Support Staff</strong></td>
<td></td>
<td>$7,165</td>
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<td></td>
</tr>
<tr>
<td><strong>GRAND TOTAL</strong></td>
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<td></td>
<td>$69,830</td>
</tr>
<tr>
<td>Total # of students</td>
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<td></td>
</tr>
<tr>
<td>Cost per student</td>
<td>$199.51</td>
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</tr>
</tbody>
</table>
COST SAVINGS RESULTS

- Redesigned courses reduce costs by 40% on average, with a range of 20% to 77%.

- Collectively, the 30 courses project a savings of about $3.6 million annually.

- Final Round I & II results show savings of $2,066,258 compared with projected $2,204,527.
WHAT HAPPENS TO THE SAVINGS? $3.6 Million Annually

- Stay in department for continuous course improvement and/or redesign of others
- Provide a greater range of offerings at upper division or graduate level
- Accommodate greater numbers of students with same resources
- Stay in department to reduce teaching load and provide more time for research
- Redesign similar courses
- Miscellaneous
  - Offer distance sections
  - Reduce rental expenditures
  - Improve training of part-time faculty
GENERAL CHEMISTRY (Lecture-Lab-Recitation)

- Inconsistent student academic preparation
- Inability to accommodate different student learning styles
- Inadequate student interaction with learning materials
- 15% rate of failures, D grades and drops
- Inability of students to retain what they have learned (amnesia)
- Inability of students to apply chemical principles to other disciplines (inertia)
ACADEMIC GOALS

- Enhance quality by individualizing instruction
- Assess students’ knowledge in much smaller subject-matter chunks
- Provide feedback and direction to allow students to make up for specific deficiencies
- Help students learn to identify their own deficiencies and do their own remediation
- Incorporate examples and information from other disciplines
- Provide a means by which chemistry can be reviewed by students in subsequent courses
TRADITIONAL COURSE

$89,955 per section

- 15 weeks, 350 students, 6 contact hours per week + 1 quiz/exam hour
- 1 professor
  - 2 lectures per week
  - 11 quizzes, 4 exams
  - 2 office hours per week
  - Supervise TAs
- 8 TAs
  - Attend lectures
  - Proctor and grade quizzes and exams
  - Lead 2 discussions and 2 labs per week
  - Attend orientation, staff meetings
REDESIGNED COURSE
$64,590 per section

- Eliminates 1 lecture per week
- Eliminates 1 discussion per week
- Access modules 24 x 7
- Adds 1 help lab w/lab monitor per week
- Other labs are unchanged

- Savings = $25,365 per section
- 8 sections in fall semester = $202,920
- Annual savings for 4100 students = $297,127
LINEAR ALGEBRA
(Taught in Multiple Sections)

- Inconsistent student academic preparation
- Inability to accommodate different student learning styles
- Inadequate student retention
- Inability of students to retain what they have learned (amnesia)
- Inability of students to apply mathematical principles to other disciplines (inertia)
- Lack of uniformity in learning outcomes
ACADEMIC GOALS

- Enhance quality by individualizing instruction
- Assess students’ knowledge in much smaller subject-matter chunks
- Provide feedback and direction to allow students to make up for specific deficiencies
- Provide help 75 - 80 hours per week
- Incorporate examples and information from other disciplines
- Make changes in the course as it proceeds; continuous improvement as a built-in feature
TRADITIONAL COURSE

$91 per student

- Two-credit course
- 1520 students
- 40 students per section
- 38 sections
- 2 hours per week for 15 weeks
- 10 tenured faculty, 13 instructors, 15 GTAs
REDESIGN COURSE

$21 per student

- Two-credit course
- 1520 students
- One large “section”
- 24 x 7 in open computer lab
- 1 full-time instructor
- Graduate & undergraduate helpers 75 hours per week
- 2 technical support staff
REDESIGN MODELS

- Supplemental – Add to the current structure and/or change the content
- Replacement – Blend face-to-face with online activities
- Emporium – Move all classes to a lab setting
- Fully online – Conduct all (most) learning activities online
- Buffet – Mix and match according to student preferences
FOR MORE INFORMATION
WWW.CENTER.RPI.EDU

- Full project plans
- Monograph
- Progress reports
- Completed course planning tools
- Project contacts
WHAT’S NEXT
THE ROADMAP TO REDESIGN (R2R)
THE ROADMAP TO REDESIGN (R2R)

- Another “proof of concept”
- Academic practices
  - Psychology, Statistics, Spanish, Pre-calc math
  - Repository of research-based materials
- Streamlined redesign methodology
  - Pedagogical techniques and models
  - Cost reduction techniques and models
- Goal: accelerate institutional adoption
- Guidelines: February 1, 2004
“IT’S NOT HOW FAST YOU RUN; IT’S HOW YOU RUN FAST.”

Are you taking full advantage of information technology?