

# Studio Courses in Engineering

Jack M. Wilson, Acting Provost  
2001



Wilson: <http://cde.rpi.edu>

# Undergraduates Too Often Shortchanged in the Past



- Nevertheless, the research universities have too often failed, and continue to fail, their undergraduate populations. Tuition income from undergraduates is one of the major sources of university income, helping to support research programs and graduate education, but the students paying the tuition get, in all too many cases, less than their moneys worth.
  - The Carnegie Foundation

# Are Research Universities Cheating Undergraduates?



- “Untrained teaching assistants groping their way...tenured drones who deliver set lectures from yellowed notes,” anybody we know?
- A report released by the Carnegie Foundation for the Advancement of Teaching bluntly accused the nation’s research universities of false advertising.
  - What’s New @ APS by Robert L. Park

# Restructuring strategy



- Replace Large Lectures with Studios
- Create 4 X 4 Curriculum
- Expand into new markets with Distributed Learning

# Philosophy of the Studio Course

- Integrate the Learning of Fundamental Concepts and Professional Practice Skills
- Learn By Discovery
- Combine Analytic, Simulation and Experimental Approaches

# Features of the Studio Courses



- De-emphasize lecture
- Combine Lecture/Recitation/Lab
- Constructivist approach
- Multimedia courseware
- Theater in the Round Classroom
- Multipoint video/audio/collaborative

# ECSE STRATEGY



- Move All Large Enrollment Courses (>50) to Studio Format
  - Timing Determined by Facilities
- Eliminate Traditional Lab Courses
  - (but NOT labs!)
  - Merge Labs with Theory Courses
- Add Hands-On Experiences to Courses That Now Have NO Associated Labs

# The Studio Classroom



- Hesburgh Award 1995
- Boeing Outstanding Educator Award 1995
- Pew Prize 1997



# The old model



**Faculty working very  
hard while the  
students listen (rest?).**

**Students working very hard while  
the faculty listen (rest?).**



**Faculty working very  
hard while the  
students listen (rest?).**

# No more lectures



- Mini-lectures
- Cooperative Learning - Teams
- Peer instructions
- Teacher as mentor
- Hands on
- Combine Lecture/Recitation/Lab
- Distributed Educational Systems

# No more books?



- Of course! Texts
- Interactive Texts
- Web Access to Resources/Databases
- Full Motion Video
- Data Acquisition/Analysis/Visualization
- Live Links to Experts

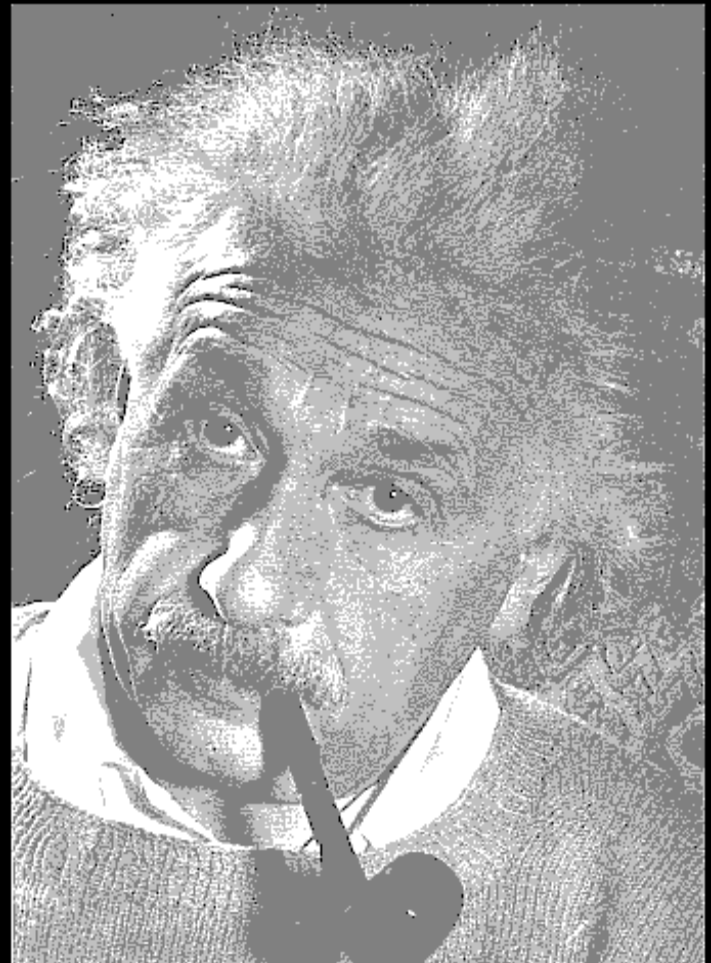
# No more dirty looks



- An improved classroom climate
- Able to address diversity
  - Learning styles
  - Gender/Race/Culture
  - Interests
  - Preparation
- Developing Cooperative and Leadership Skills

# What happens to me?

- Will the Web or a CD-ROM Replace your <Blank> Instructor?

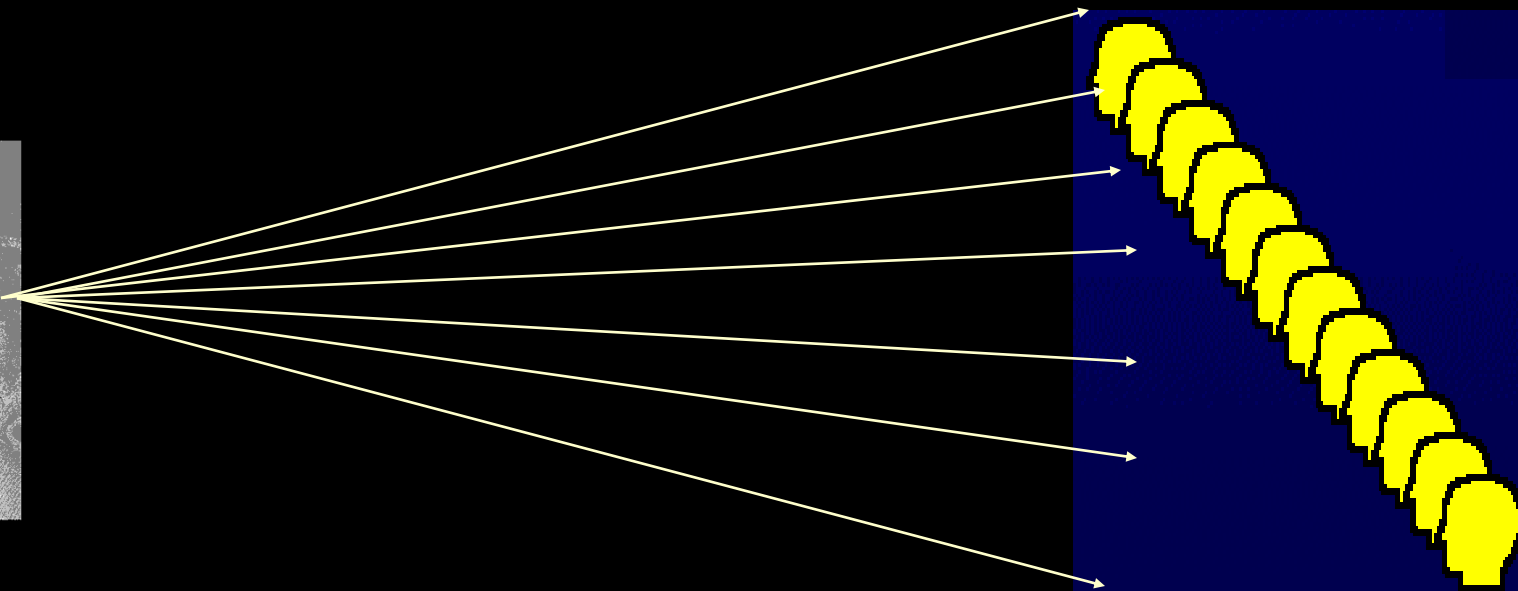
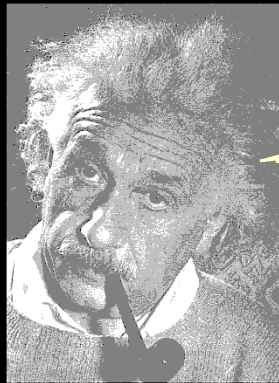


# Faculty fears and legislators hopes

- Prism: "If a student can zoom the best professors into his or her living room, then what is to happen to the rest of the countries professors?" (the mainframe model!)
  - In a word: hogwash.
- Presenting is not teaching!

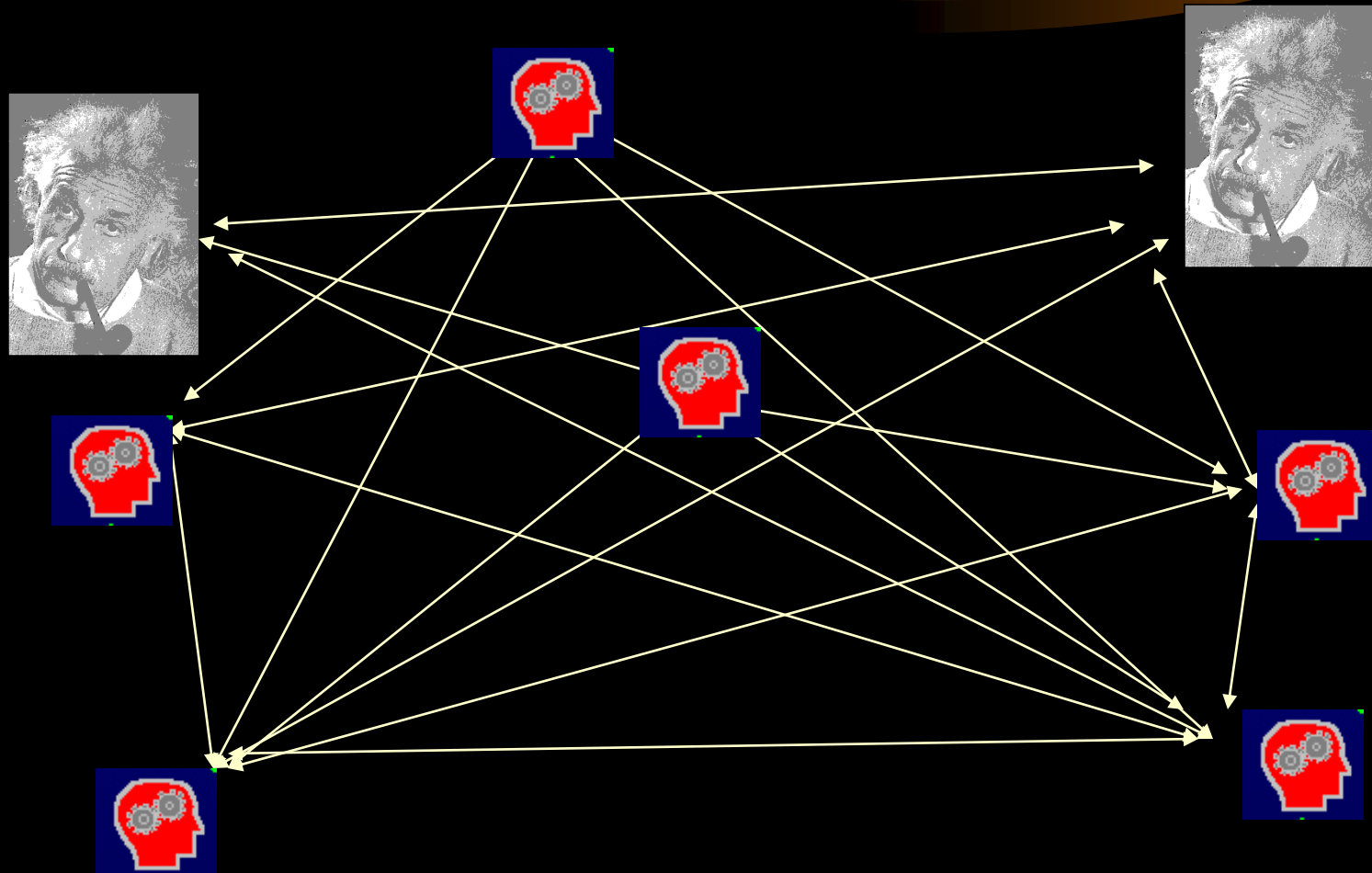
# The transmission model

- The mainframe approach





# Distributed Collaborative Model



# Distributed Cognition



- The "Client-Server" model.
- Connecting students, instructors, and resources into a rich interacting community of learners.
- Peer Teaching
- Cooperative Learning
- Student-student as well as student-instructor and student-resource interactions
- Synchronous as well as asynchronous
- Video/Audio/ and Multimedia interactions
- The real "World Wide Web"

# Learning: The Killer App



- Is Learning the "Killer App" of the next generation of computing?

# Evolution of Computing

- First we thought the PC was a calculator
- Then we thought it was a typewriter
- with multimedia we thought that it was a TV
- Now, with the World Wide Web.....  
we've realized it's a (four color sales) **brochure**.  
..... Douglas Adams,  
Author Hitchhiker's Guide to the Galaxy

# The Fact:



- It is the worlds best communication tool  
combined with what will be the
- World's Largest Library  
Creating the First and Only
- Global Continuous Learning Environment

# Relentlessly changing the way we

- Labor

- Live

- Love

and

- Learn

# The Forty Year Degree



- Christopher Galvin,  
President Motorola:
- We are not hiring any more graduates with four year degrees.
- We want employees with forty year degrees

# The Introductory Course



750 - 1100  
Students

Calculus (1100)

Physics (750)

Chemistry (650)

Intro. to Engineering Analysis (650)

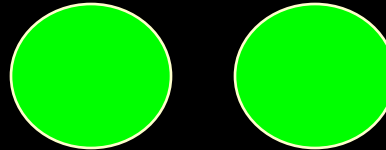
Economics (~300)

(and now many advanced courses)



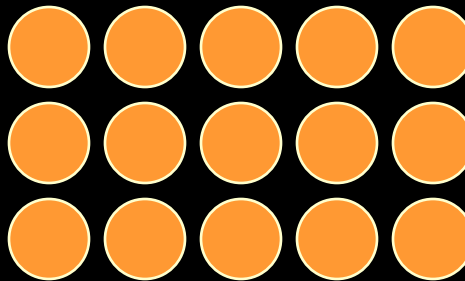
# The Introductory Course

2 Lectures

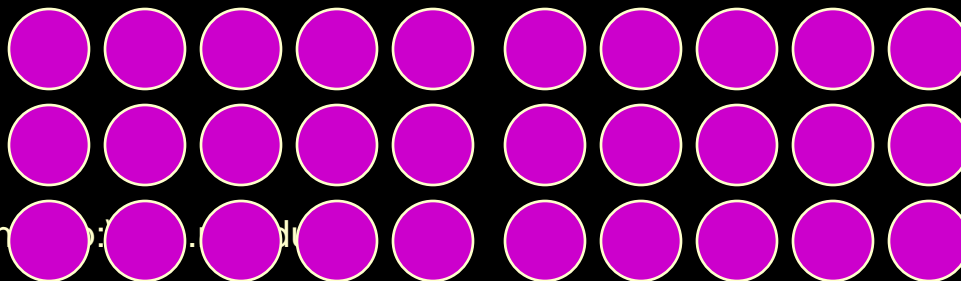


25-30 Recitations

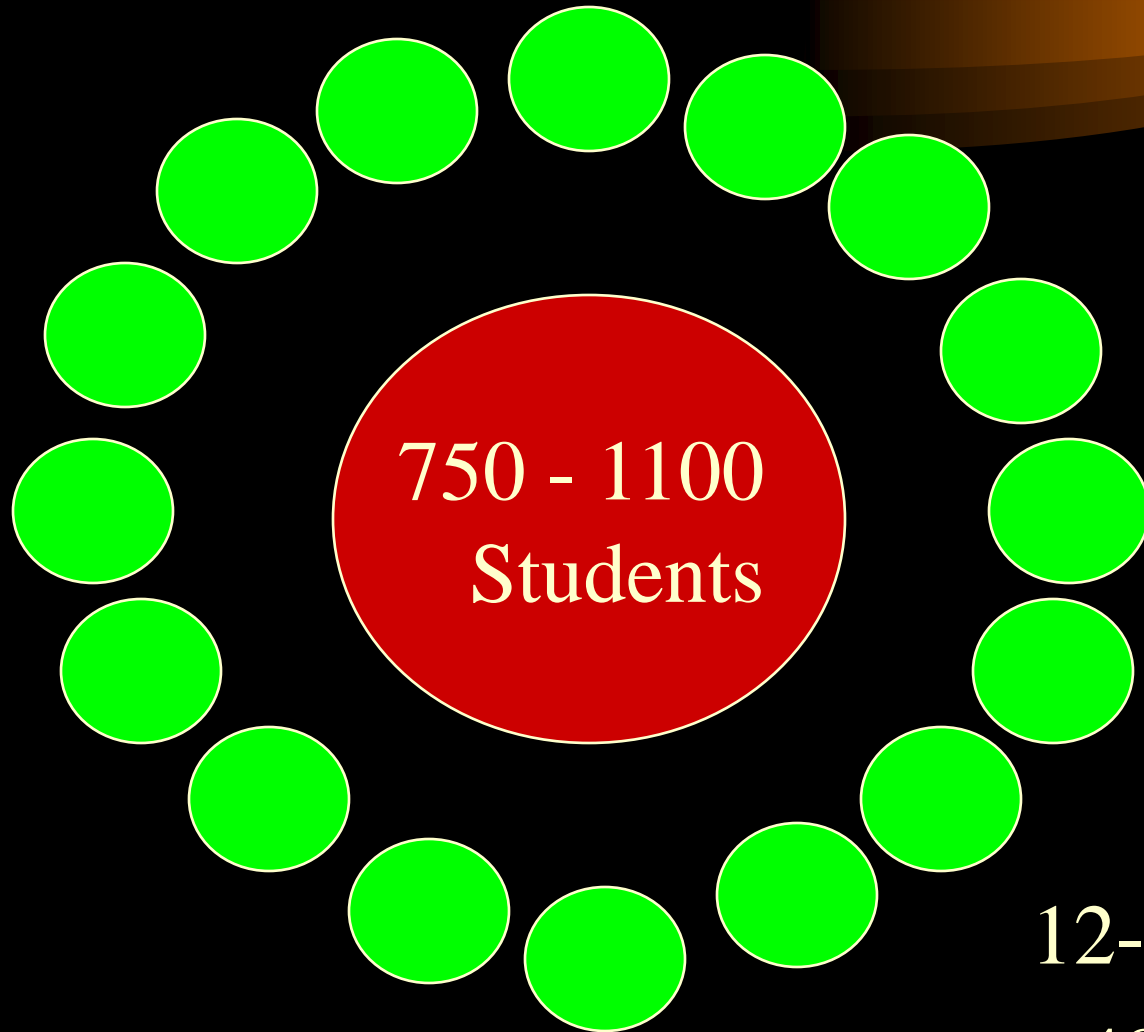
750 - 1100  
Students



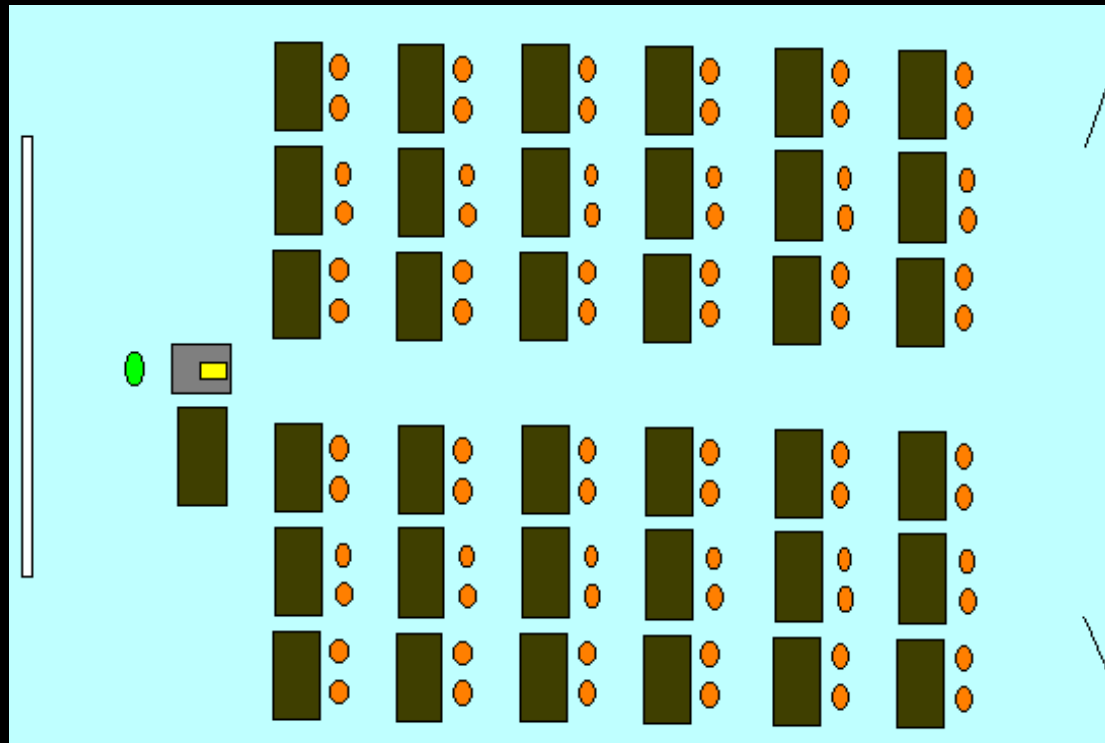
30-40 Labs



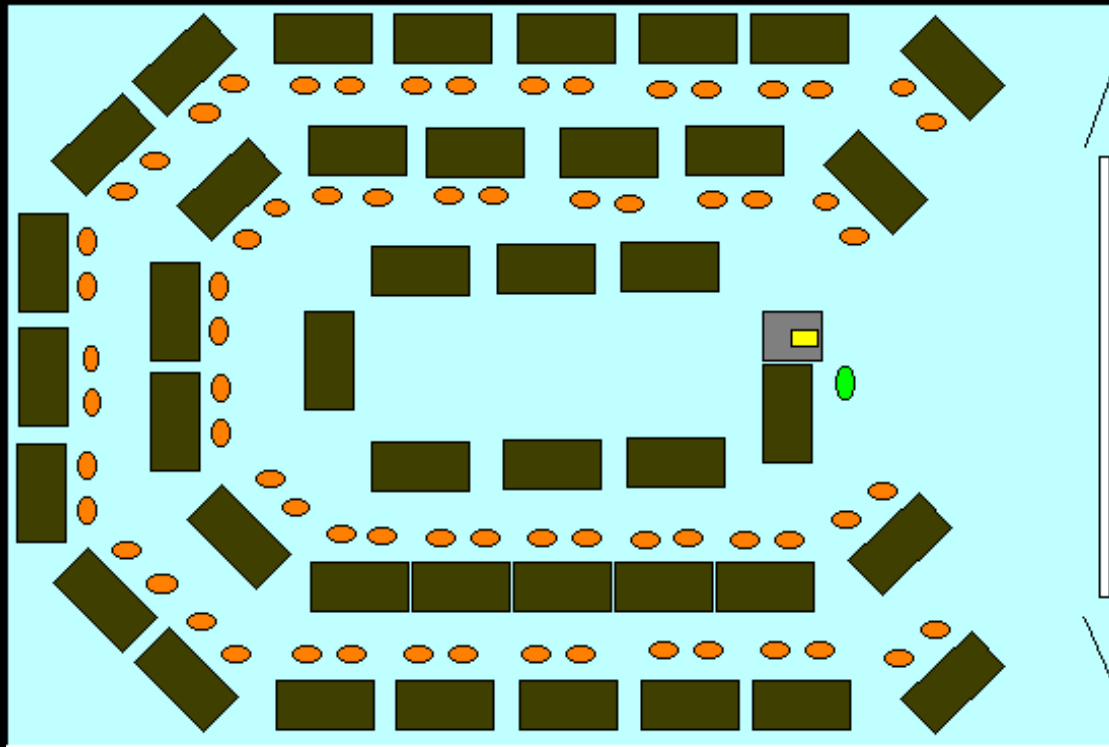
# The Introductory Course



# The Traditional Classroom



# The Studio Classroom



# The CUPLE Physics Studio

## Traditional

- Credit Hours: 4
- Contact Hours 6
  - 2 Hours Lecture
  - 2 Hours Recitation
  - 2 Hours Lab

## Studio

- Credit Hours: 4
- Contact Hours 4



# The CUPLE Physics Studio

- (20 min) Problems Due - Discussion
- (40 min) Hands-on Group Activity
- (10 min) Discussion
- (15 min) Another Group Activity
- (15 min) Mini Lecture: Formalism
- ( 5 min) Conclusion

# Studios in ECSE

- Circuits Studio - 1500 ft<sup>2</sup>- 42 Students
- Instrumentation Studio - 1200 ft<sup>2</sup> - 36
- Computer Studio - 1200 ft<sup>2</sup> - 36
- Control Studio - 1500 ft<sup>2</sup> - 44
- LITEC Studio - 3600 ft<sup>2</sup> - 72
- 12 More Around Campus
  - plans for 10 more



# ECSE Studio Courses

- Computer Components and Operation
- Computer Architecture, Networks and Operating Systems
- Laboratory Introduction to Embedded Control
- Electric Circuits
- Analog Electronics
- Microelectronics Technology
- Digital Electronics
- Electronic Instrumentation
- Fields and Waves I
- Signals and Systems
- Discrete Time Systems
- Control Systems Engineering
- Still More to Go





# ECSE Studio Approach

- 2 Hour Classes, 2-3 Times Per Week
- Several Activities Each Class
  - Mini-Lectures
  - Discovery Exercises
  - Simulation Activities
  - Interactive Discussions
  - Hands-On Experimentation
  - Analytic Problems



# Other Studio Courses



- Calculus (1100 students / yr)
- Physics (750)
- Chemistry (650)
- Intro. to Engineering Analysis (650)
- Economics (~300)
- Biology

# Results



- Significant improvement: Student Satisfaction
- Significant improvement: Faculty Satisfaction
- Equal or better performance on regular exams.
- Year long Rutgers led evaluation
- Significant Attendance increase
- Cost containment
- Ongoing longitudinal study

# Results Specific to ECSE



- Much Better Attendance
- Course Ratings Improved
- Instructor Ratings Improved
- Some Improved Learning
- Improved Computer/Hands-On Skills
- Students and Faculty Love It!!

# The Virtual Classroom

- Hand-raising
- Floor passing
- Annotation
- Q and A
- Feedback
- Application sharing



# The End



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# Our Strategies



- Follow our corporate partners throughout their own globalization process
  - ex: GM into Mexico, Luxembourg and elsewhere
- Focus on Engineering, Management and Technology, Computer Science, and Information Technology
- Offer old, new, and leading edge technologies.

# RSVP



- 10 Years +
- '93 Telecon "Best Distance Learning Program"
- '96 USDLA Industry-University Collaboration
- 944 Students in Credit/Degree Courses
- Several hundred more in short courses
- Bringing education to the workplace
  - (GM, IBM, Lockheed Martin, AT&T, Lucent, Con Ed, GE, UTC, Pratt & Whitney, Ford, Intel, Applied Materials, Matsushita, Bugle Boy, Albany International, Key Bank, +++++)

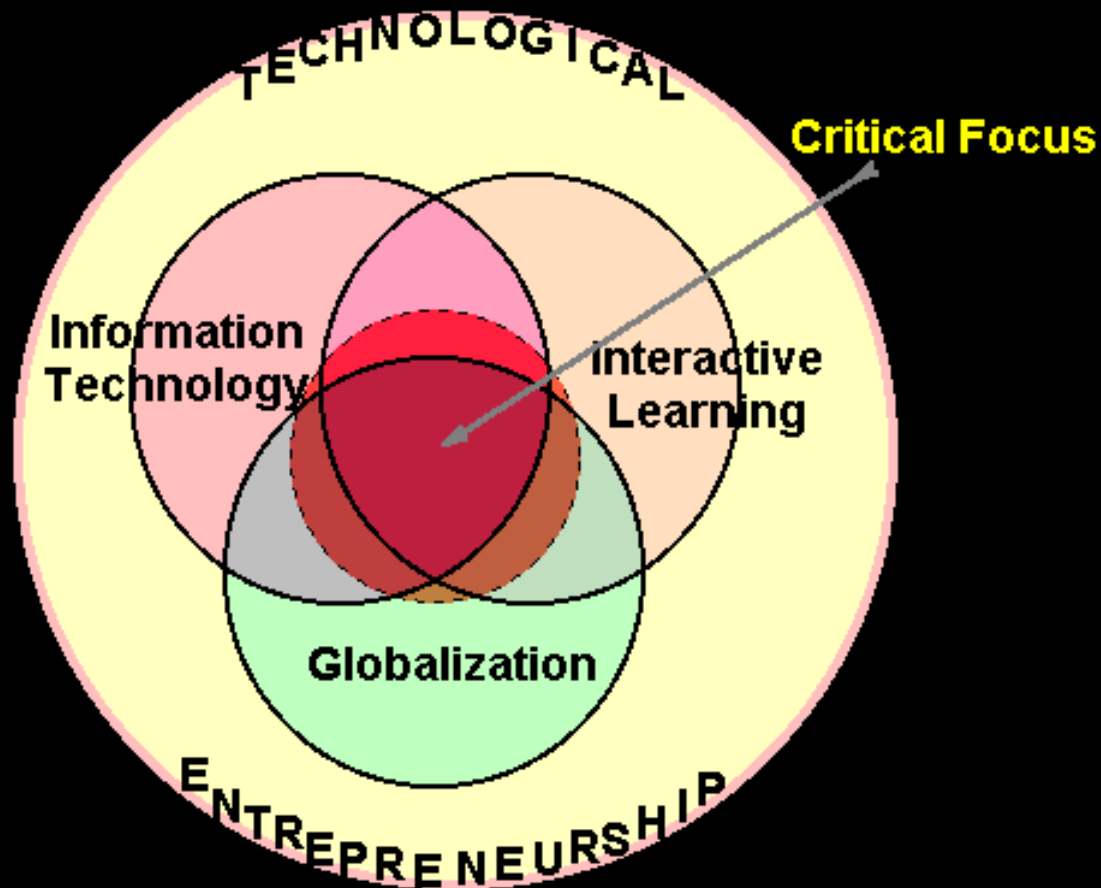


# Technologies in Use



- Satellite Video
- ISDN Videoconferencing
- CD-ROM Creation
- Mail out materials
- World Wide Web materials
- ILINC LearnLinc
  - Desktop Video (multicast)
  - Network based materials management
  - Classroom management
- Software Spin Off: ILINC

# Our Strategies



# “Venture Capital”



- RSVP Reserve Fund
- Strategic Investment Fund
- Our Partners
  - Ex: HCI Certificate and IBM
- Operations

# NTU-Rensselaer Course

- Satellite broadcast
- Hands On Exercises
- Synchronous Tutoring
- Asynchronous support



# NTU-Rensselaer Course



## Hands-On World Wide Web

- Feb 10 & 17, 1998
- 8000 participants
- 500 sites
- Most successful NTU course ever
- “The future of satellite based education.”
  - Lionel Baldwin, President, NTU

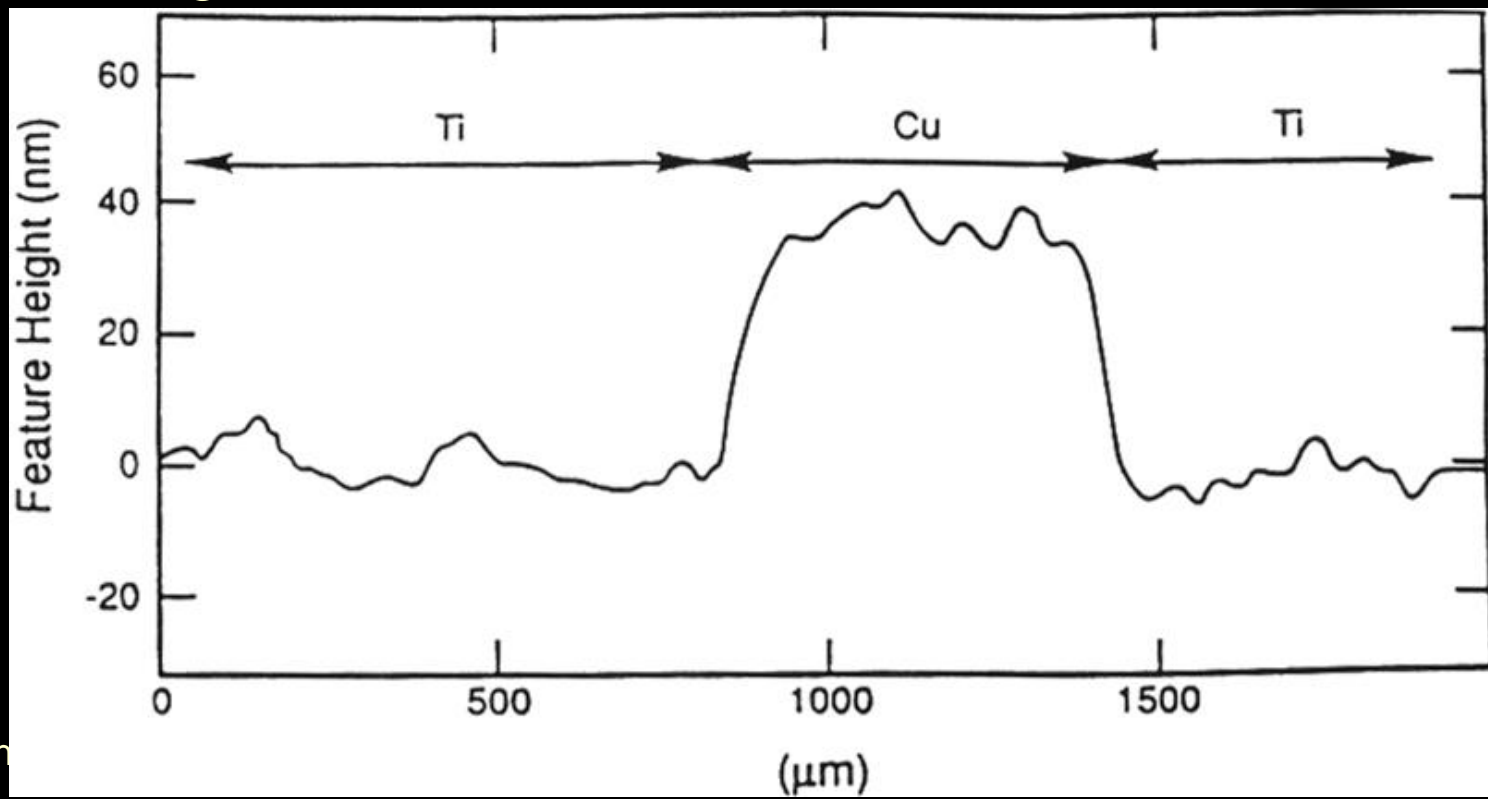
# Rensselaer and Hong Kong City U.

- Survival Skills for Astrophysics
- Professor Chun Ming Leung
  - Graduate Students in Astrophysics
    - Video/Audio/ ILINC Web Data Conf.
    - Both ISDN and Internet connection
    - 7 am Eastern ( 6 Hong Kong)
    - Student Collaborative Presentations
    - One Semester length

# Chemical Mechanical Planarization

- RPI/Intel/Applied Mat./ Matsushita/IBM
- Murarka, Schowalter, Duquette
  - (Introduction to Copper Metalization)
  - (Wall Street Journal article)
- Month long course to engineers and scientists in the workplace.
- Video/Audio/ILINC Web data Conf.
  - ISDN and Internet
  - ProShare, PictureTel, Panasonic multipoint

- Profilometer trace showing dishing of the titanium liner relative to the adjacent recessed copper metal. An electrochemical interaction between the copper metal and the titanium accelerated the normally low polish rate of titanium to produce the negative dishing.





# Albany International Paper

- Management and Technology

Gene Simons

- North America
- South America
- Europe
- Australia
- Asia

- Face to Face first then PictureTel and Web

# Rensselaer at Hartford



- Formerly Hartford Graduate Center
- Originally founded to provide graduate engineering education to Hartford corporations
- Merged last year
- Now 91% Management and 9% Engineering

# Vision of the virtual classroom



- Student Centered
- Web of instructors, students, and resources
- Studio model of instruction
- Peer teaching
- Live video and audio plus canned multimedia
- Synchronous (~20%) & Asynchronous instruction
- Lowered unit cost of instruction

# Oregon Graduate Institute

- 155 Faculty members
- 4 Student/Faculty
- Doctoral Students: 116 Full 23 Part
- Masters: 109 Full 168 Part
- Research: \$12 million



# OGI Fields



- Biochemistry and Molecular Biology
- Computer Science and Engineering
- Electrical and Computer Engineering
- Environmental Science and Engineering
- Management in Science and Technology
- Materials Science and Engineering