# Studio Courses
# Creating New Learning Environments for Higher Education

Jack M. Wilson,
CEO UMassOnline
Spring 2002

# Other interests



- Chairman & Founder of LearnLinc Corporation.
  - Gilat-Allen-LearnLinc => (NASDAQ)
- Formerly
  - Provost (interim)
  - Dean of Faculty
  - Dean of Undergraduate Ed.
  - Dean of Professional Ed.
  - Director, Center for Innovation in Undergraduate Ed.
  - Chair, Physics Department
  - Professor for 30 years +

# Are you feeling a bit overwhelmed? UMassOnline.net

- Ever feel like you are building a plane in flight?

# Undergraduates Too Often Shortchanged



- 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

# Research Universities Cheating Undergrads?



- "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

# RPI Restructuring strategy: 90-99



- Replace Large Lectures with Studios
- Create 4 X 4 Curriculum
- Expand into new markets with Distributed Learning
- Student Mobile Computing
  - laptops
- Entrepreneurship Curriculum

# Philosophy of the Studio Course



- What do you do in a lecture hall?
- What about in a studio?
- 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

# Example: 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
- Pew CAT $8.8 million

# The old model

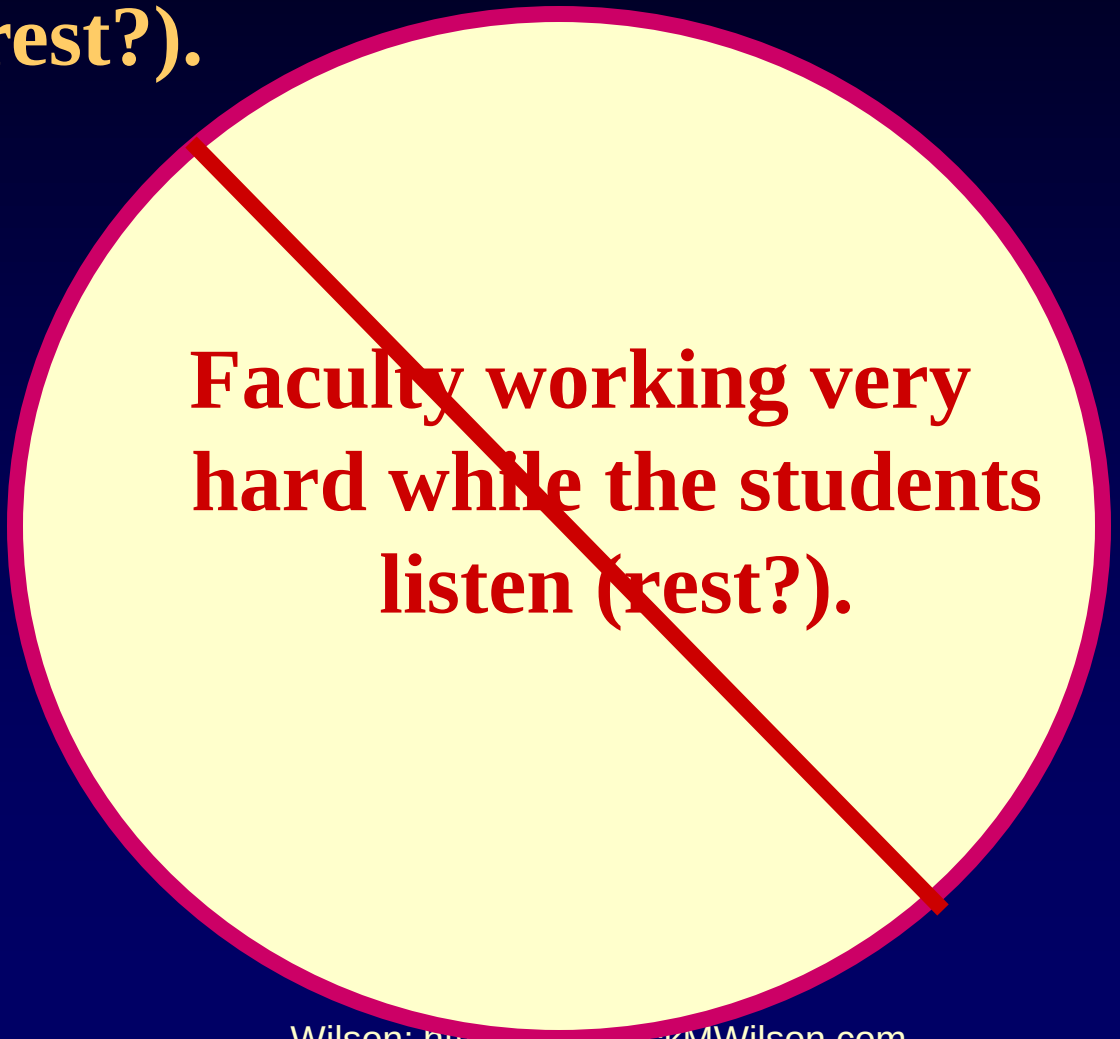


**Faculty working very hard while the students listen (rest?).**

# The New Model



**Students working very hard while the faculty 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

# The Introductory Course



750 - 1100 Students

Calculus (1100)

Physics (750)

Chemistry (650)

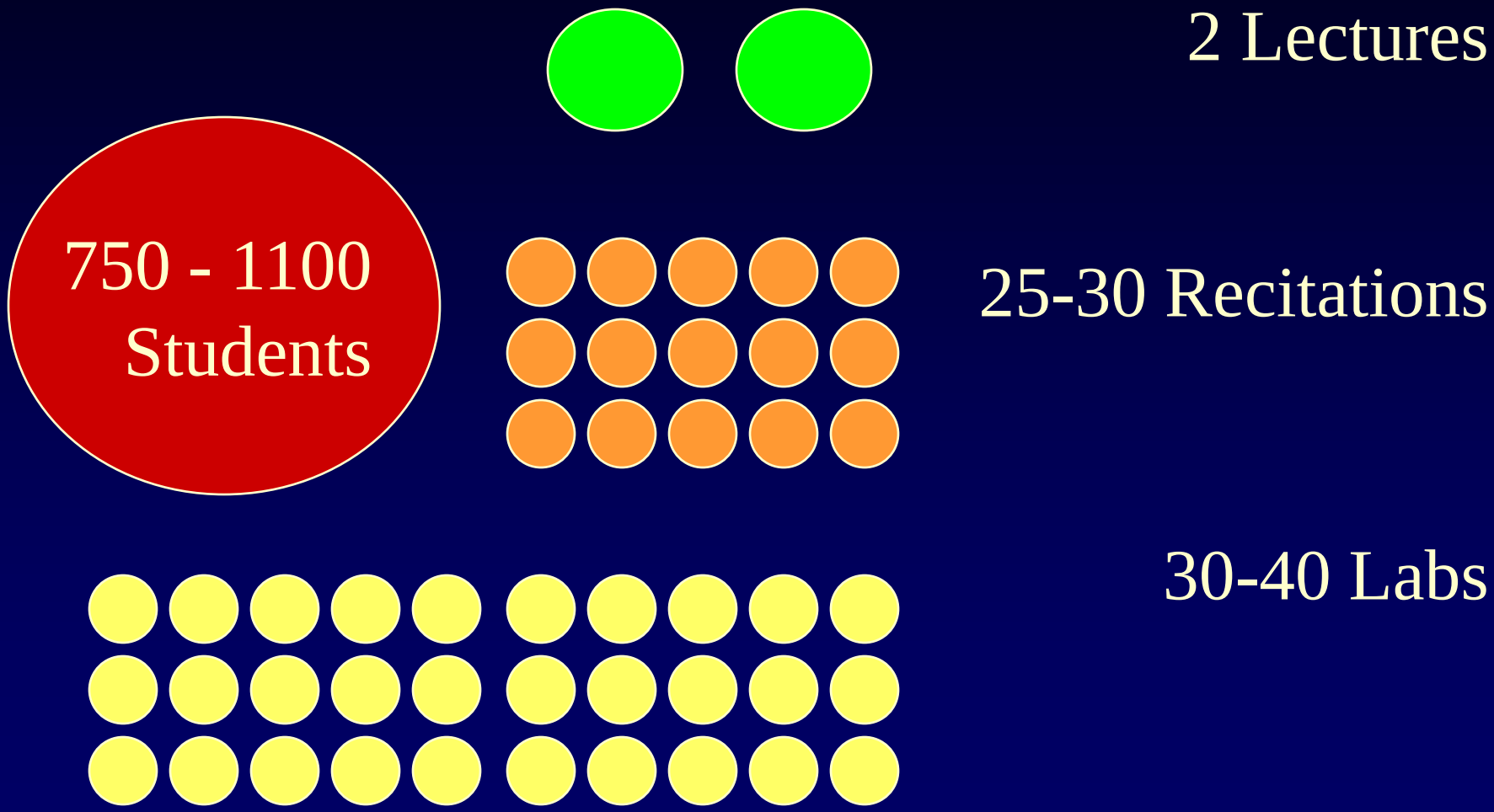
Intro. to Engineering Analysis (650)

Economics (~300)

(in the beginning)

# The Introductory Course

UMassOnline.net



# The Introductory Course

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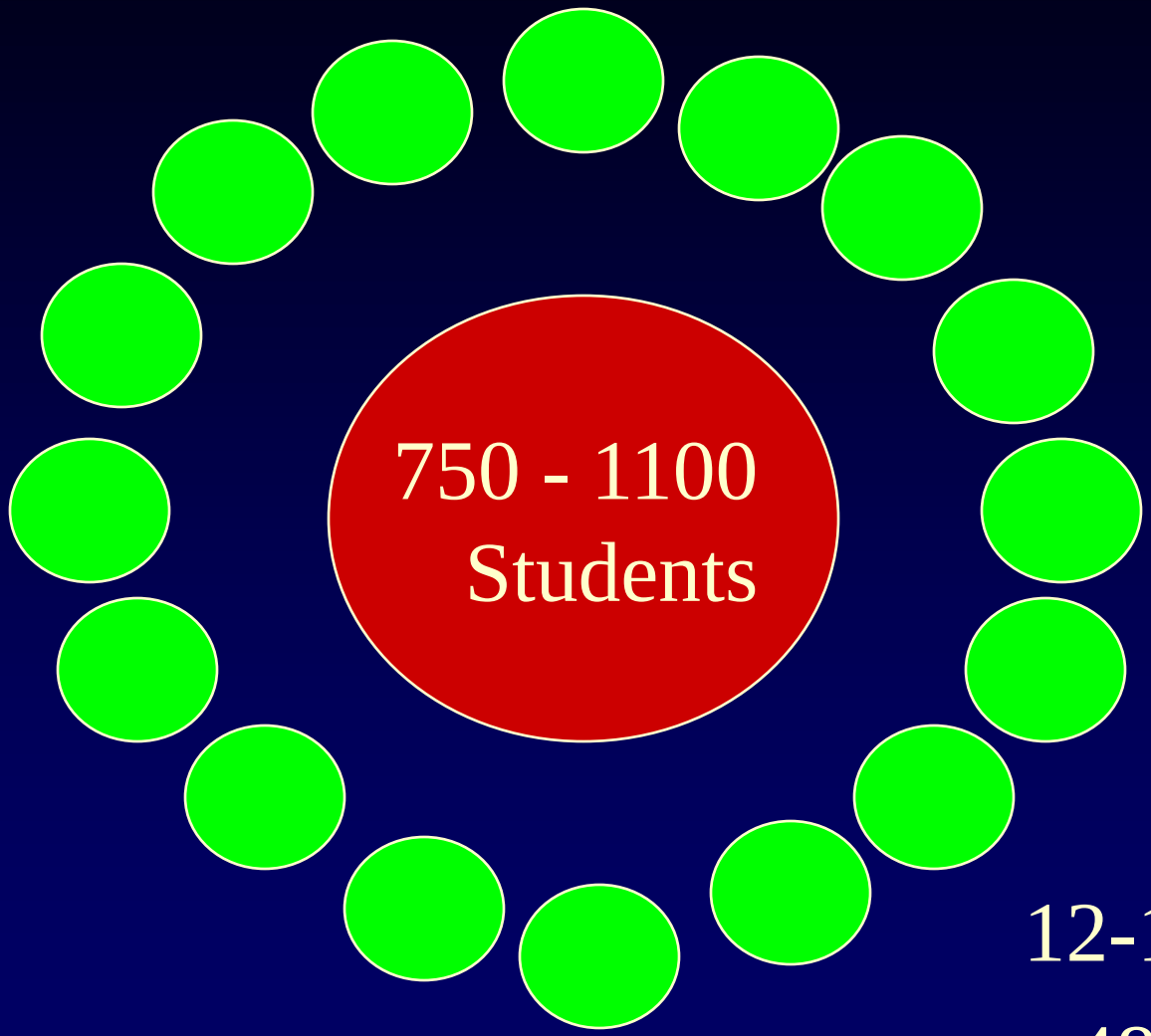
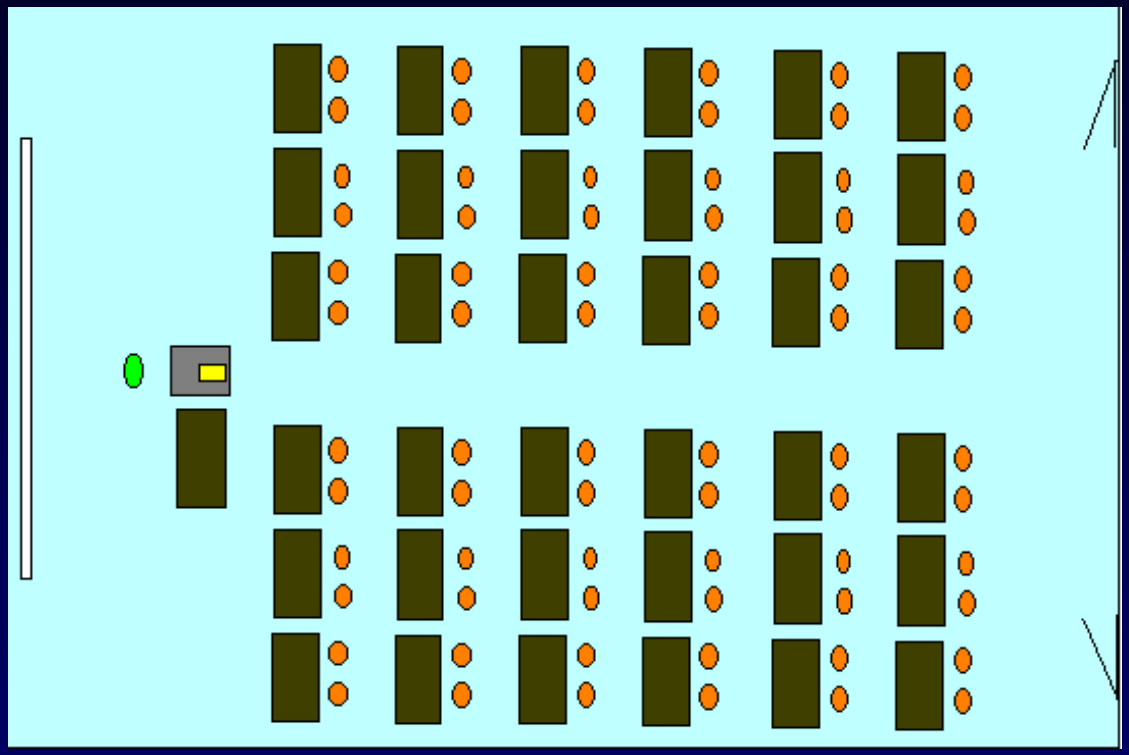



12-15 Studios

48-64 each

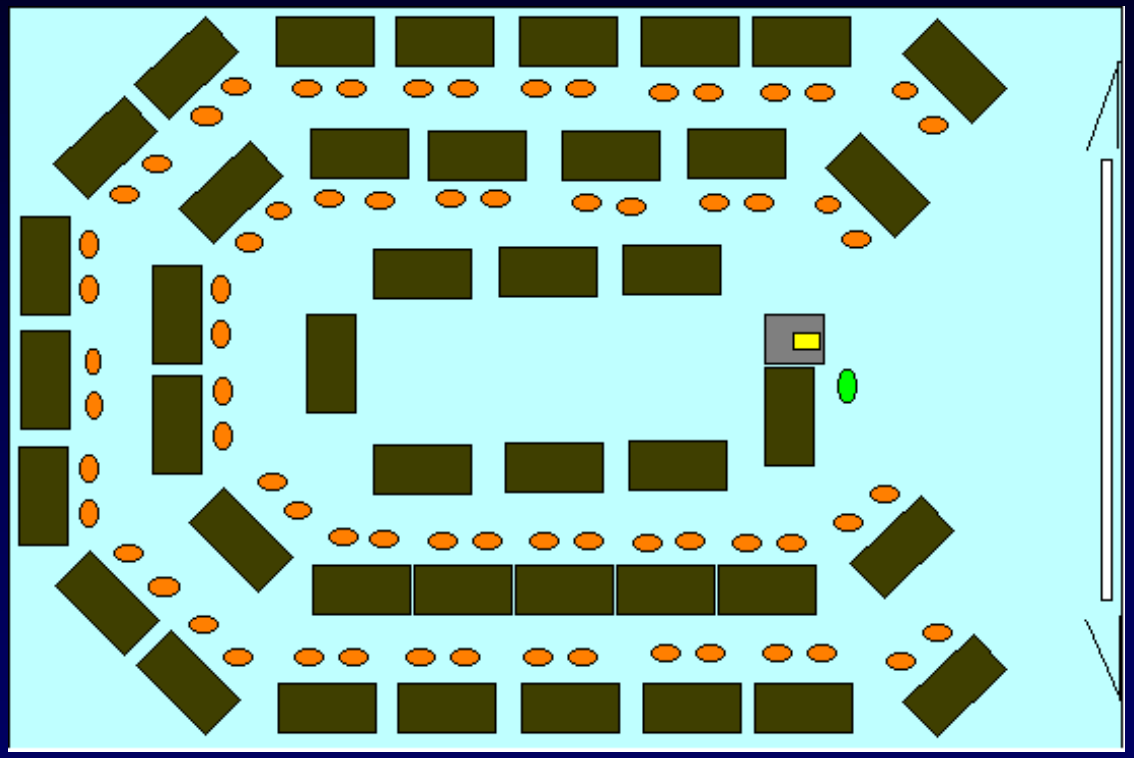
# The Traditional Classroom

UMassOnline.net



# The Studio Classroom





# The CUPLE Physics Studio

UMassOnline.net

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

# Physics Studio Tools



- Microcomputer Based Laboratories
  - not simulation!  Data acquisition.
- Video Tool
- Interactive Lecture Demonstrations
- Simulations
- problem solving

# First Day Physics



- Students running back and forth in front of the computer!
- MBL: distance, velocity, acceleration and time.
- Mouse Mechanic:
  - http://cde.rpi.edu/MouseMechanic.html

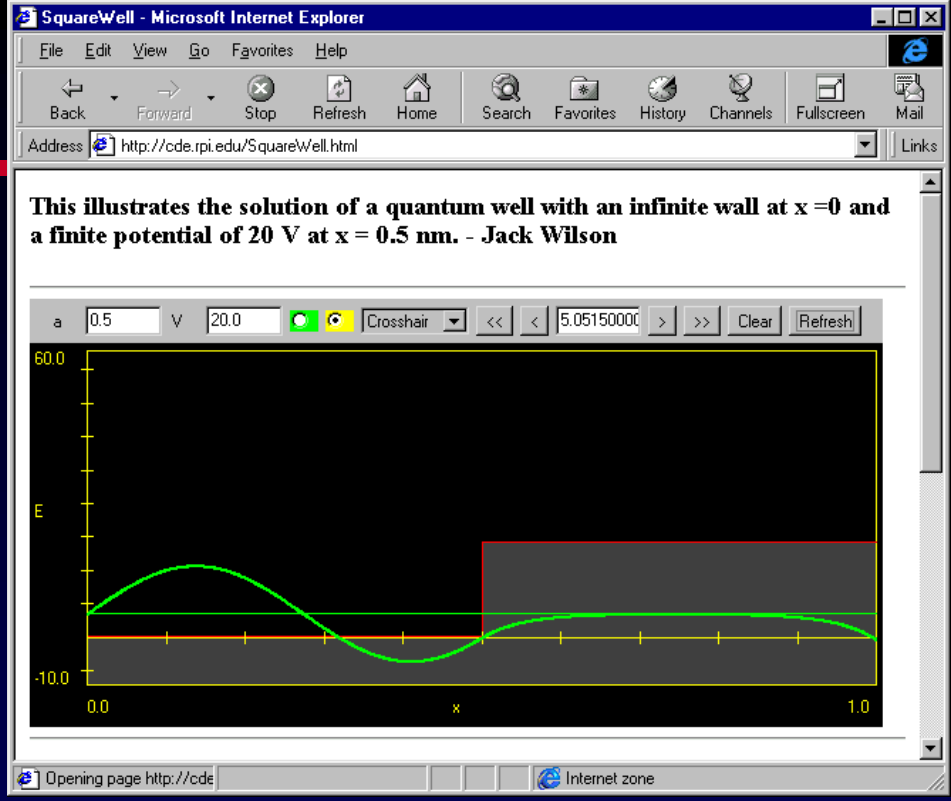
# Videotool for Mechanics



- Use this tool to track and measure movements of objects in two dimensions
- Can be done live in class.
- Try it!

# Simulations

- Used with real experiments




- Quantum Well
  - http://cde.rpi.edu/SquareWell.html
- The Pendulum
  - http://cde.rpi.edu/Pendulum.html

# How can we afford it?



- Desktop room: $100,000
- Laptop room: $25,000
- Expected life: 5 years (10 semesters+summer)
- Amortized cost $10,000 or $2500 per course
- Room serves 500 students per semester
- Cost per student $20 or $5.
  - (course costs typically $1000-3000 per student)

# Student Mobile Computing



- Laptop requirement
- 4 years of pilot
- cost crossover
- 4 year phase in
- student reaction
- faculty readiness
- key to affordability and pervasiveness

# Studios in ECSE



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

# ECSE Studio Courses

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- 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

# Metrics



- Student performance on traditional tests
- Student attendance
- Student performance on cognitive tests
- Student performance on problem solving
- Student attitudes toward the courses
- Student retention
- Faculty attitude toward the courses
- Student success in later classes

# 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 Studio at other Universities

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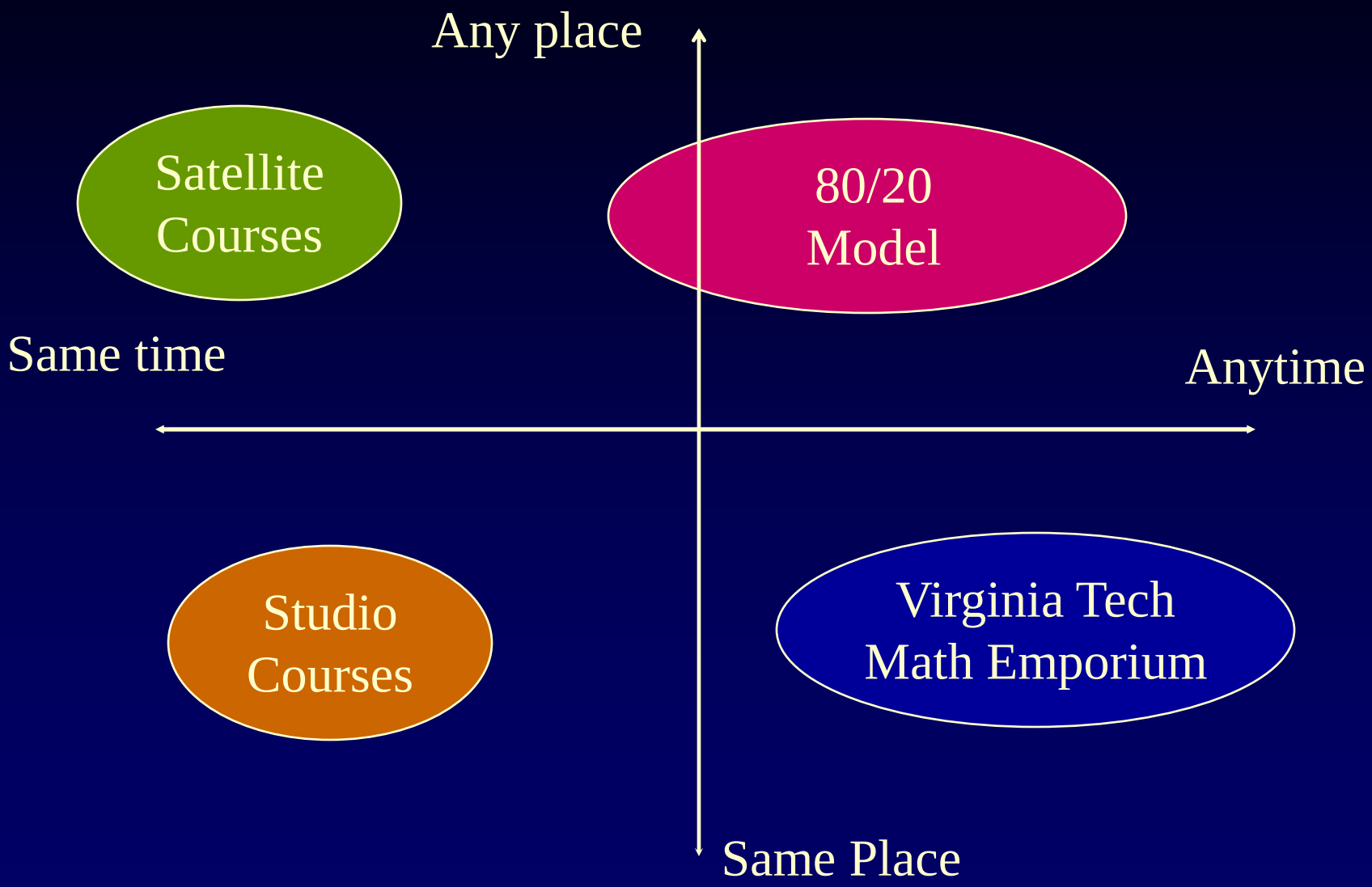
- **The University of Amsterdam (**http://www.science.uva.nl/research/amstel/)
- **Penn State University** (http://www.science.psu.edu/facaffairs/strategic.htm ) (http://www.psu.edu/ur/archives/news/GE.html ) (http://dps.phys.psu.edu/about.htm )
- **Arizona State University** (http://www4.eas.asu.edu/phy132/ )
- **Indiana State Univ**. (http://physicsstudio.indstate.edu/ )
- **Cal Poly San Luis Obispo** (http://www.cob.calpoly.edu/Evan/polyplan/polyplan.htm) (http://chemweb.calpoly.edu/phys/ )
- **Ohio State University** (http://www.physics.ohio-state.edu/~ntg/26x/2064_pictures.html )
- **The University of Amsterdam** (http://www.wins.uva.nl/research/amstel/ )
- **The University of New Hampshire** (http://einstein.unh.edu/academics/courses/ )
- **Curtin Univ. of Tech. (Australia)** (http://www.physics.curtin.edu.au/teaching/studio/ )
- **Univ. Of Mass. –Dartmouth** (http://www.aps.org/meet/CENT99/BAPS/abs/S3455002.html )
- **The Colorado School of Mines** (http://einstein.mines.edu/physics100/frontend/main.htm)
- **Acadia Univ. (Canada)** (http://ace.acadiau.ca/math/boutilie/ )
- **Santa Barbara City College** (http://www.cs.sbcc.net/physics/redesign/final_report/reportb.html )

# Do you feel like you are herding cats?



# The Studio at a Distance

UMassOnline.net



# Studio at a Distance

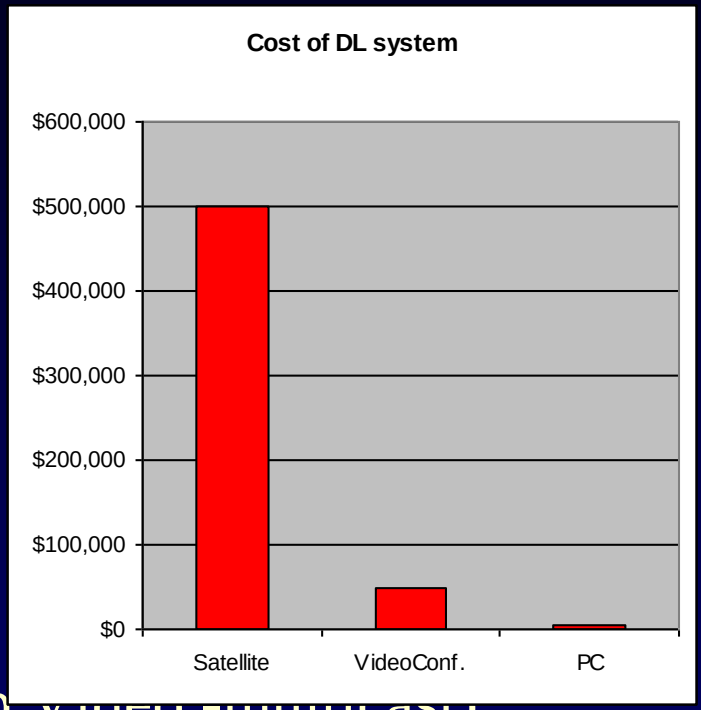
UMassOnline.net

- Delivery on standards based multimedia PC's equipped for live video/audio interactions and connected to a robust ip multi-casting network.
- A mix of synchronous and asynchronous activity.
- Use of Web and/or CD-ROM based multimedia materials.
- Use of professional quality software tools for CAD, symbolic math, spreadsheets, word processing, etc.
- Live audio and/or video interactions among the students and with faculty.
- Email interactions among the students and faculty.
- Small group discussions.
- Collaborative software for application sharing over the network.
- Access to rich resources on the network.
- Ability to "pass the floor" to students to allow them to lead the class through an activity.
- Course administration software to track student progress.
- Classes with a mix of students in traditional and workplace settings.
- Classes with a global perspective and global audience.

# Distance Learning Technologies

UMassOnline.net

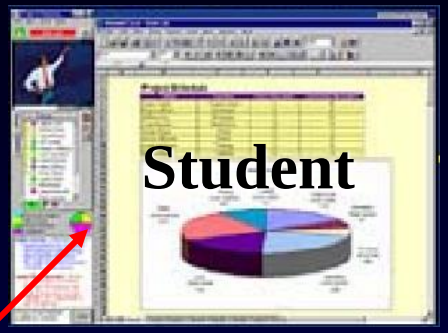
- Satellite Video ($500,000)
- ISDN Videoconferencing ($50,000)
- PC Collaborative ($5,000)
- Web Based Asynchronous ($5,000)



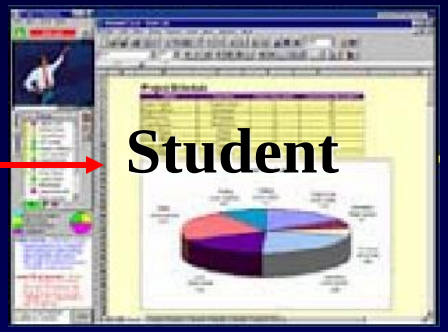

- Example: ILINC LearnLinc
  - Live Internet Audio (optional Desktop Video -multicast)
  - Network based materials management
  - Classroom management

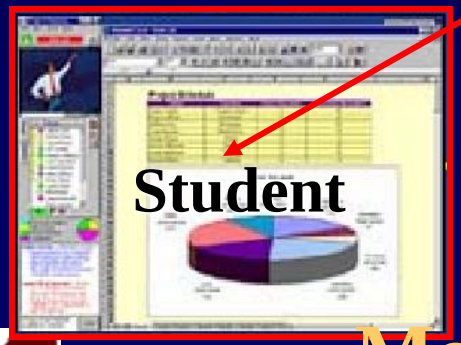
Instructor

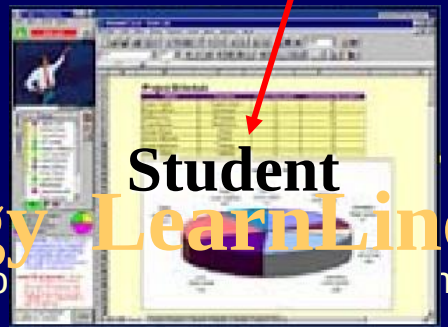
LearnLinc WebServer

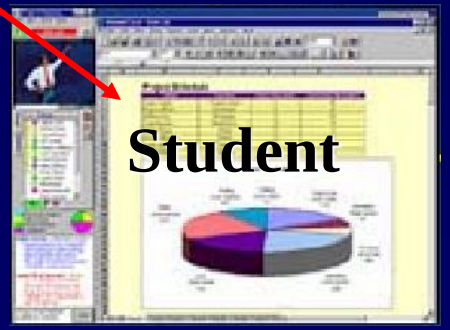



The Internet
Voice & Data



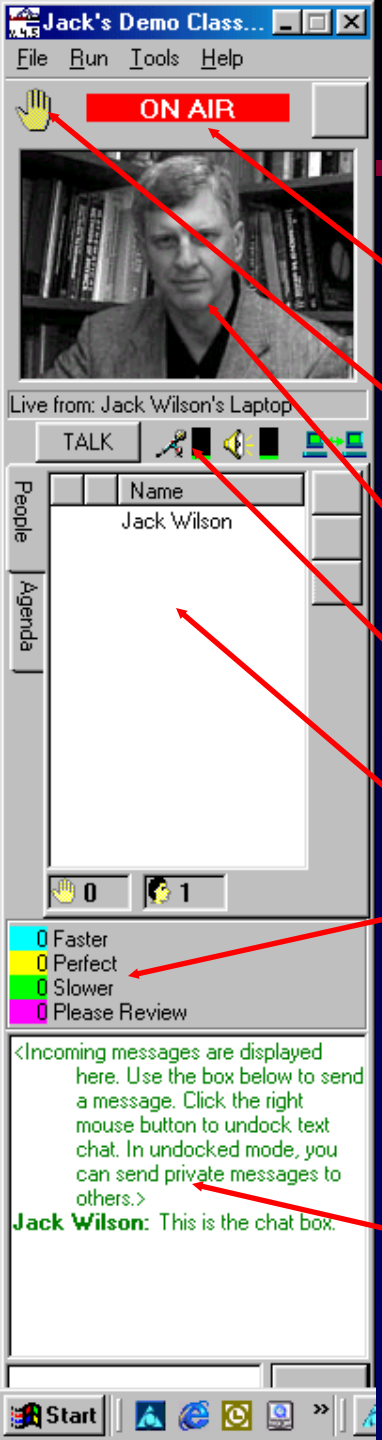




Mentergy LearnLinc

# Introduction to eBusiness

UMassOnline.net

- Fall 2000: Tuesday night from 6:30-8:30 pm
  - 50 On Campus Students
  - 75 Off Campus Students
    - IBM, Ford, GE, Lockheed Martin, Pratt and Whitney, Ford, Consolidated Edison, NY Power, J. P. Morgan, Carrier, Otis, etc.
  - Extensive Website:
    - http://www.jackmwilson.com/eBusiness/Syllabus-Spring2001/
  - MBA, MSIT, MS
  - miniLectures, Discussion, Student presented cases, & asynchronous interactions
- Spring 2001: 75 overflow students (25 on and 50 off)

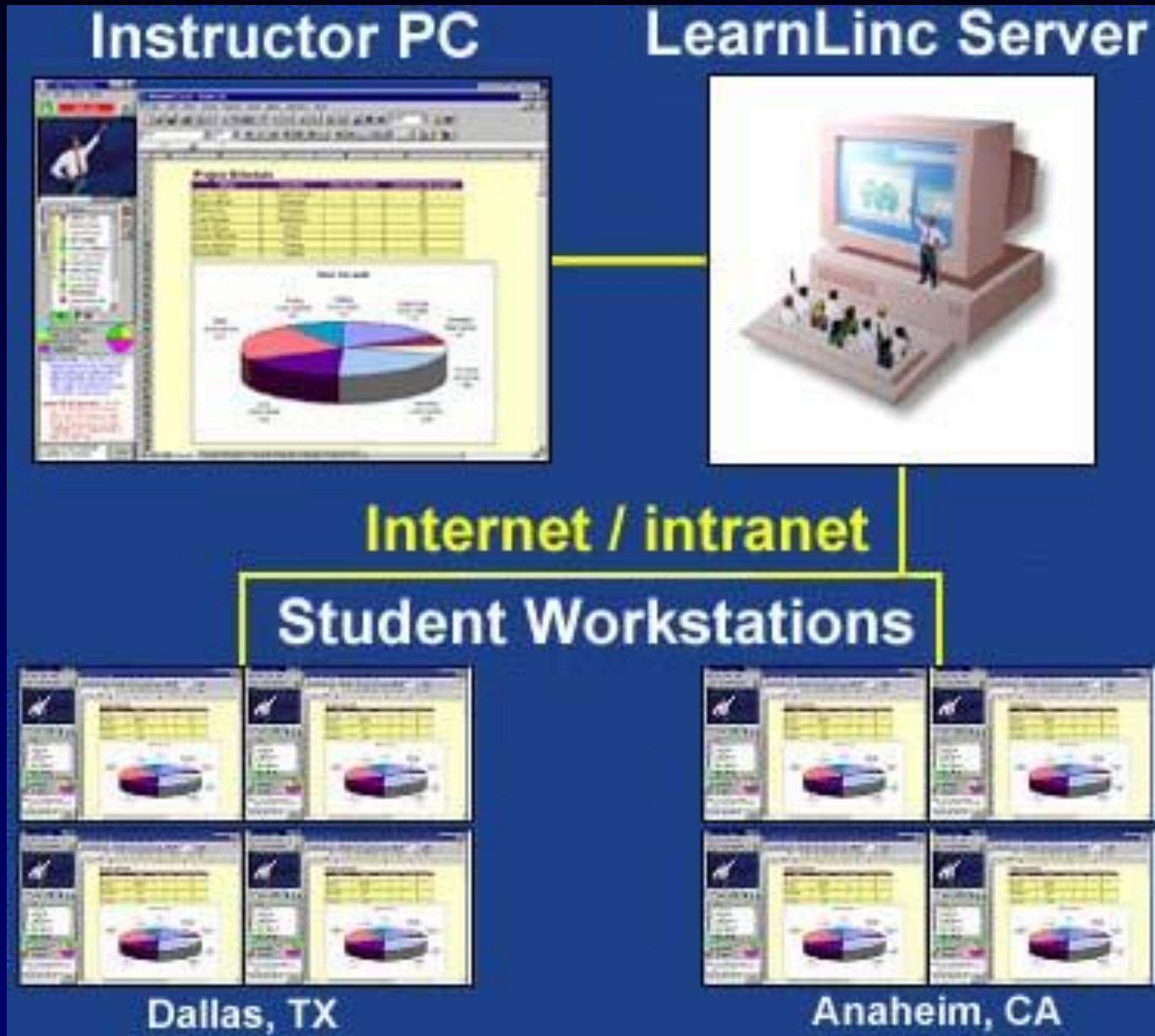



- On- Air indicator
- Raise your hand
- Picture or video of speaker
- Audio and Network controls
- Agenda or class roll
- Feedback section (also Q n A)
  - (can be pace, agreement, T/F, Yes/No, etc.)
- Chat Window (also Whiteboard etc.)

# LearnLinc

UMassOnline.net

- ILINC LearnLinc distributed learning system
  - –Video-audio-collaboration-synchronous-asynchronous
- founded in 1994 by one faculty (Wilson) and two alums (Bernstein and Usluel)
- RPI Research joint with AT&T and Bell Labs
- Began in incubator
- Moved to Tech Park
- Bootstrap start-up and two rounds of venture including one with Intel.



# NTU-Rensselaer Course

UMassOnline.net

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

# 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



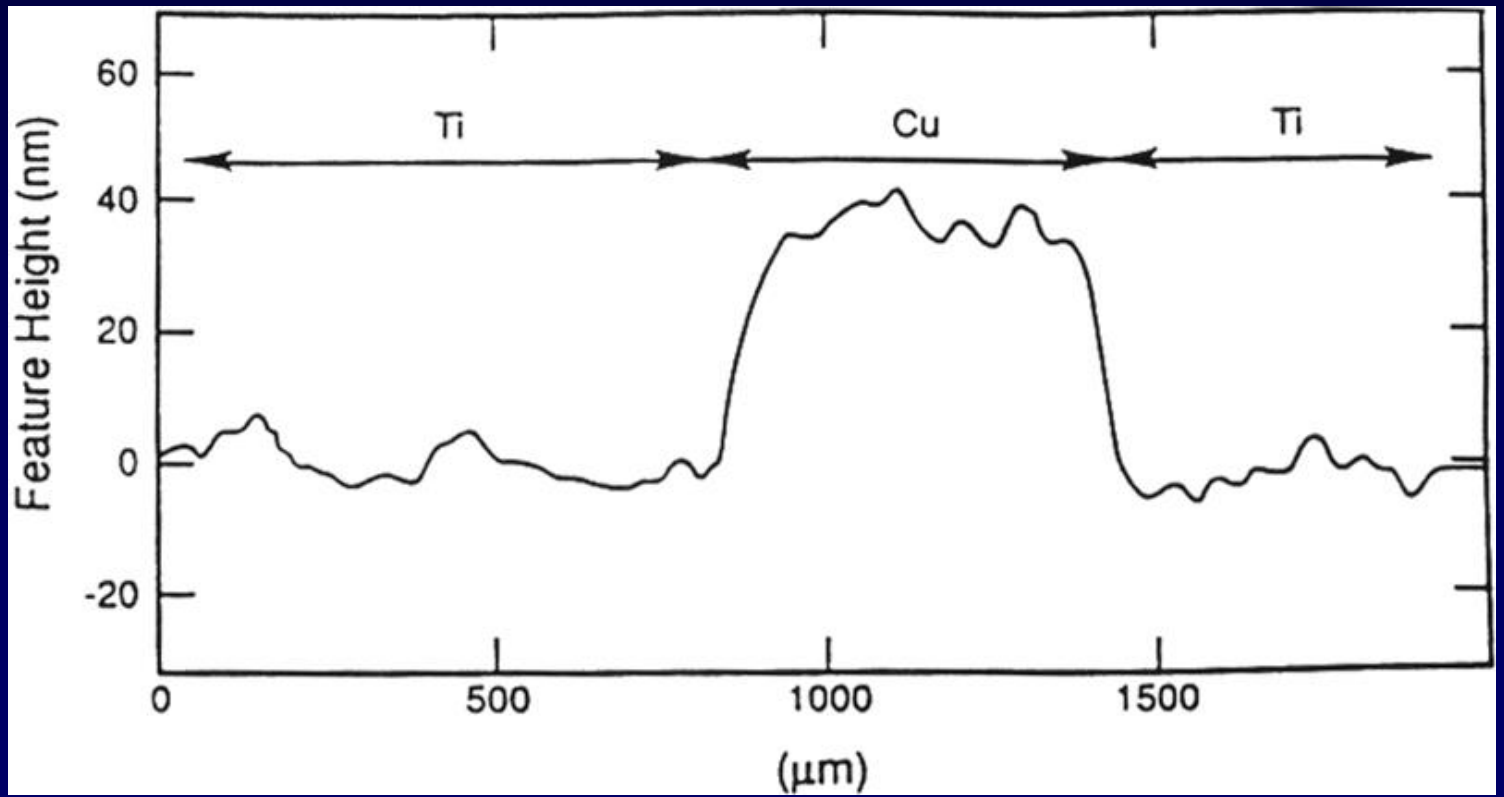
- RPI/Intel/Applied Mat./ Matsushita/IBM
- Murarka, Schowalter, Duquette
  - (Introduction to Copper Metalization)
  - (Wall Street Journal article)
- Month long course to engineers and scientists in the workplace.

- Video/Audio/ILINC Web data Conf.
  - ISDN and Internet
  - ProShare, PictureTel, Panasonic multipoint

# Chemical Mechanical Planarization



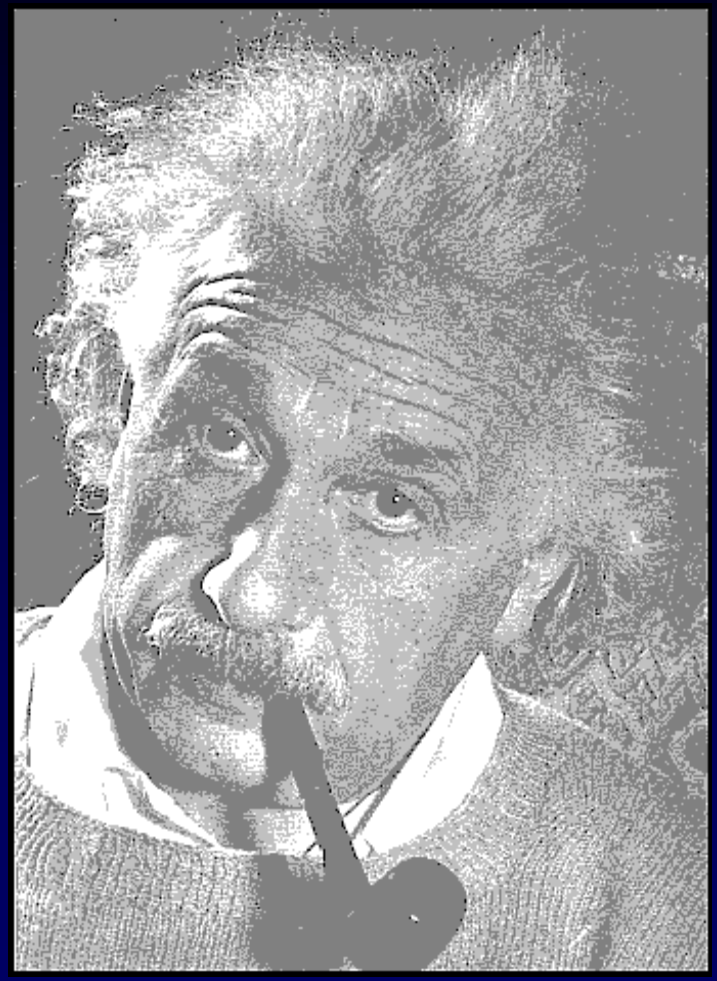
- Profilimeter trace showing dishing of the titanium liner relative to the adjacent recessed copper metal. An electrochemical interaction between the copper metal and the titanium accelerated the normally low polish rate of titanium to produce the negative dishing.



# What happens to me?



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



# Faculty fears and legislators hopes

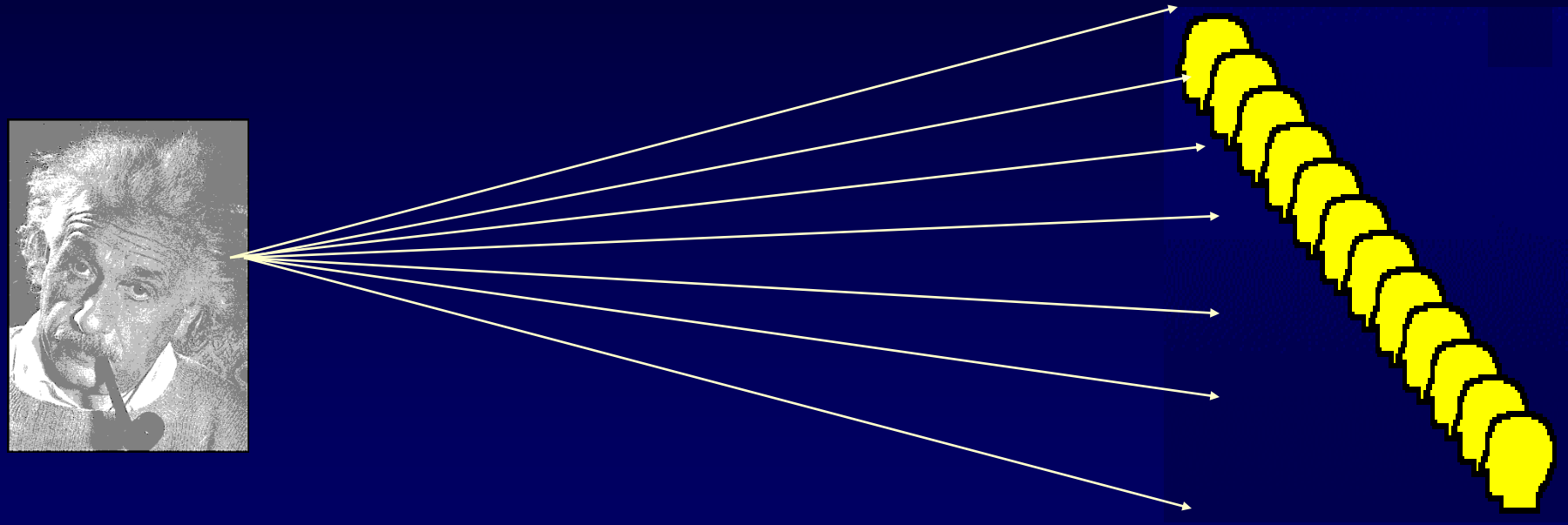


- Prism: "If a student can zoom the best professors into his or her living room, then what is to happen to the rest of the countries professors?" (the mainframe model!)
  - In a word: hogwash.
- Presenting is not teaching!

# The transmission model



- The mainframe approach



# Distributed Collaborative Model

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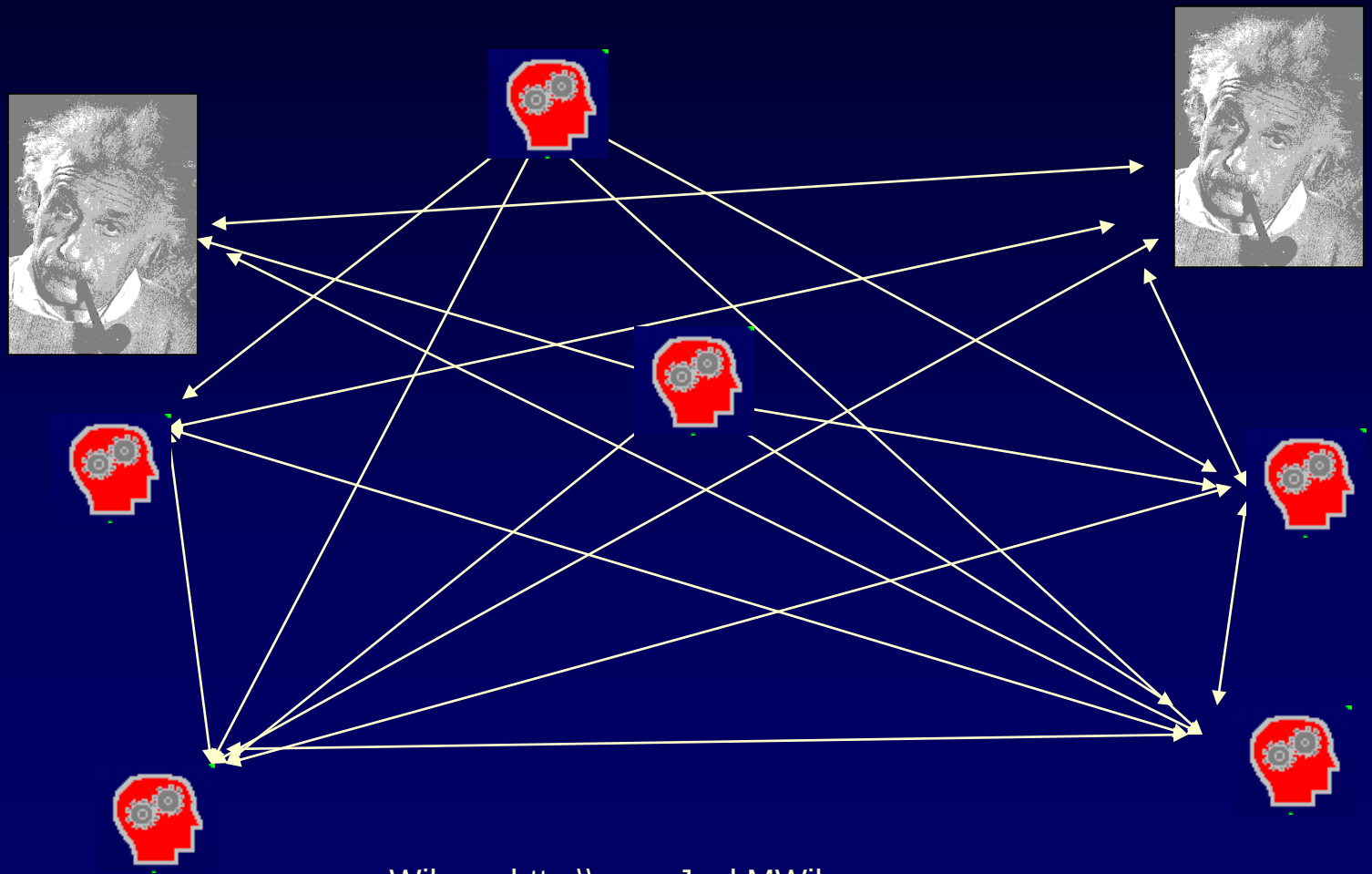

# Technology Ten Commandments

1. Restructure around the learner. Neither over-emphasize nor under-emphasize technology.
2. Build upon research results, which inform design; don't try to reinvent the wheel.
3. Remember that technology has an intrinsic educational value beyond helping students learn better.
4. Do systematic redesign and not incremental add-ons. There is always a tendency to just add on a few computer experiences to everything else. By definition this costs more, is more work for faculty, and adds to the students' burden. An innovative approach changes rather than adding poorly integrated exercises.
5. Benchmark your plans and build upon examples of systematic redesign. Do not automate the lecture. Find the best examples and build upon them.

# Technology Ten Commandments

6. Count on Moore's law ("What is hard today is easy tomorrow").
   - For example, cpu power and bandwidth have consistently improved.
7. Cost is an important aspect of quality. There is no lasting quality if there has been no attention to cost.
   - There are more than enough examples of expensive high quality solutions. We need more examples of inexpensive high quality solutions!
8. Avoid pilots that linger. Design for a large scale and pilot projects only as a prelude to scaling up.
   - It is easy to design innovative educational experiences that work for small groups. It is harder to address the needs of the 1000 students taking calculus I at the large research university. The Emporium is a great example.
9. Develop a balance between synchronous and asynchronous distributed learning.
10. There is no longer any way to do good scholarship without technology, and there is no longer any way to teach good scholarship without technology.

# 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

Jack M. Wilson
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http:\\www.JackMWilson.com

**The End**

# 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

# 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, +++++)

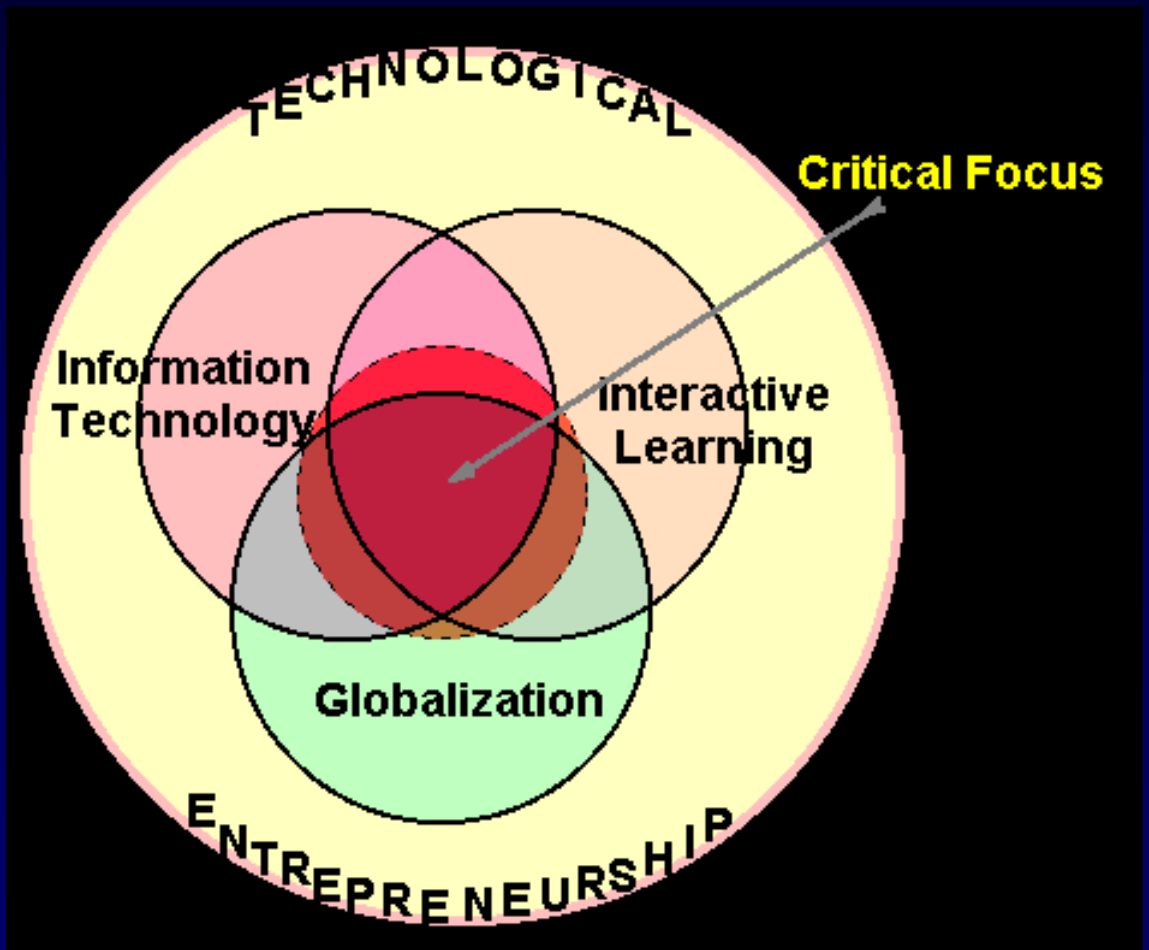
# Technologies in Use



- 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

# 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