# Reforming the Undergraduate Curriculum: Faculty Rewards and Responses

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# Other interests

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- Formerly
  - Provost (1997-99 interim)
  - Dean of Undergraduate Ed.
  - Dean of Professional Ed.
  - Director, Center for Innovation in Undergraduate Ed.
  - Chair, Physics Department
  - Professor for 30 years +
- Chairman & Founder of LearnLinc Corporation.
  - Gilat-Allen-LearnLinc => $300 million (NASDAQ)

# Undergraduates Too Often Shortchanged

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- 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

# Restructuring strategy

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

# Goals: to improve..

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- 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 experience in the courses
- student success in later classes

# Process

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- Faculty-staff-student process teams
  - Designing and Delivering Curriculum
  - Crossing the Threshold
  - Student Mobile Computing
- Faculty -staff-student implementation teams.
  - CRIT: Curriculum reform implementation team
  - Student Mobile Computing
- Faculty Senate approval
  - Faculty Senate Curriculum Committee
  - Faculty Senate Planning and Resources Committee

# The Issues

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- Very Hot Issues
  - Student mobile computing
  - Leadership requirement
- Hot issues
  - Four by Four curriculum (FS: unanimous!)
- Surprisingly supported
  - Studio Classrooms
  - Distributed Learning

# Faculty support

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- Anderson Center for Innovation in Undergraduate Education
- Computing and Information Services
- Dean’s Council
- Strategic Initiatives Program
- Various other groups

# Faculty rewards

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- Special raise pool in some schools
- Strategic Initiative funding
- Laptop Computer grants
- Consideration in the P&T process
  - Science Dean: “I’m going to turn the old equation on it’s head”
- Recognition programs
- National Recognition

# Credit where credit is due!

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- Harry Truman once said that "it is remarkable how much can be accomplished when no one cares who gets the credit."

- Harry was very wrong.
  - Credit is the primary currency of academe. It outranks even money!

# What happens to me?

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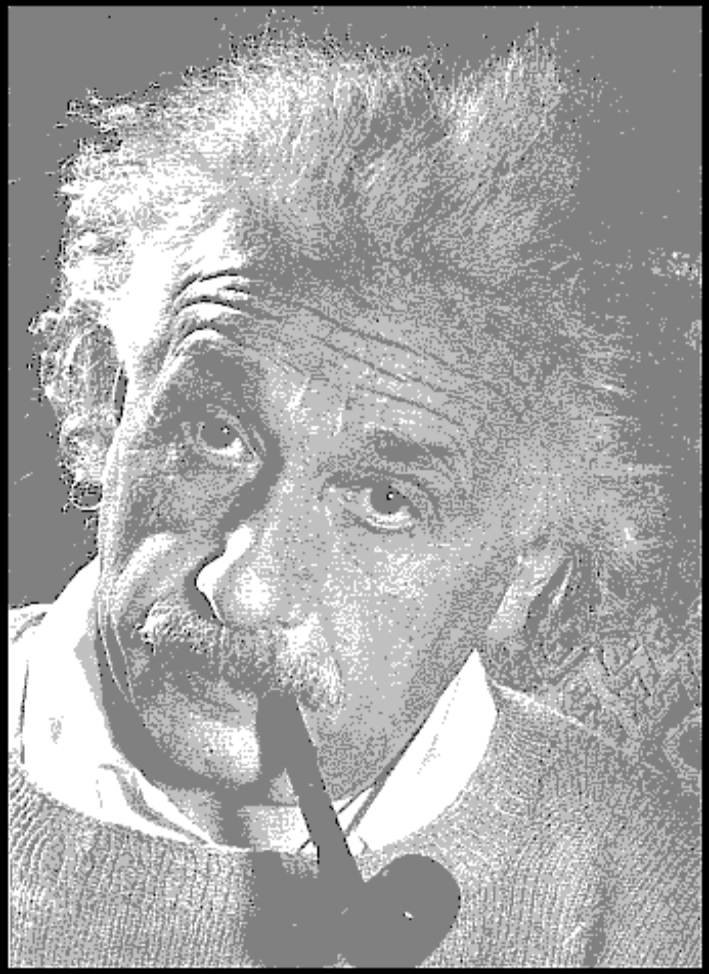
- Will the Web or a CD-ROM Replace your <Blank> Instructor?



# Faculty fears and legislators hopes

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- 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

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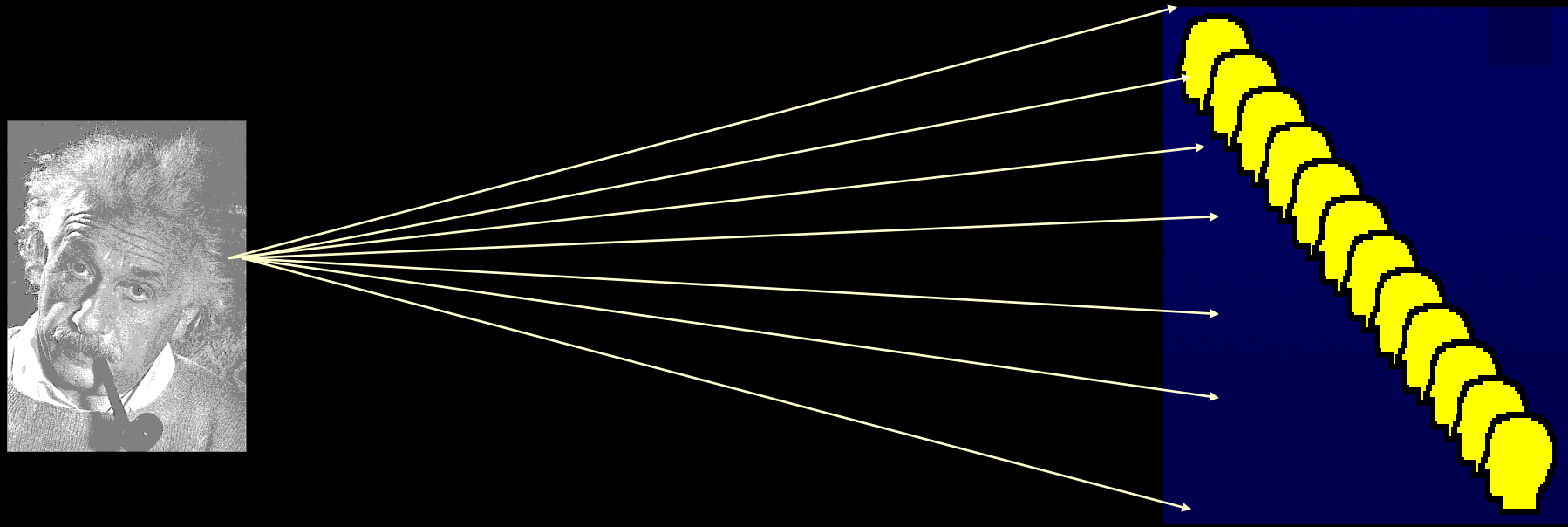
- The mainframe approach



# Distributed Collaborative Model

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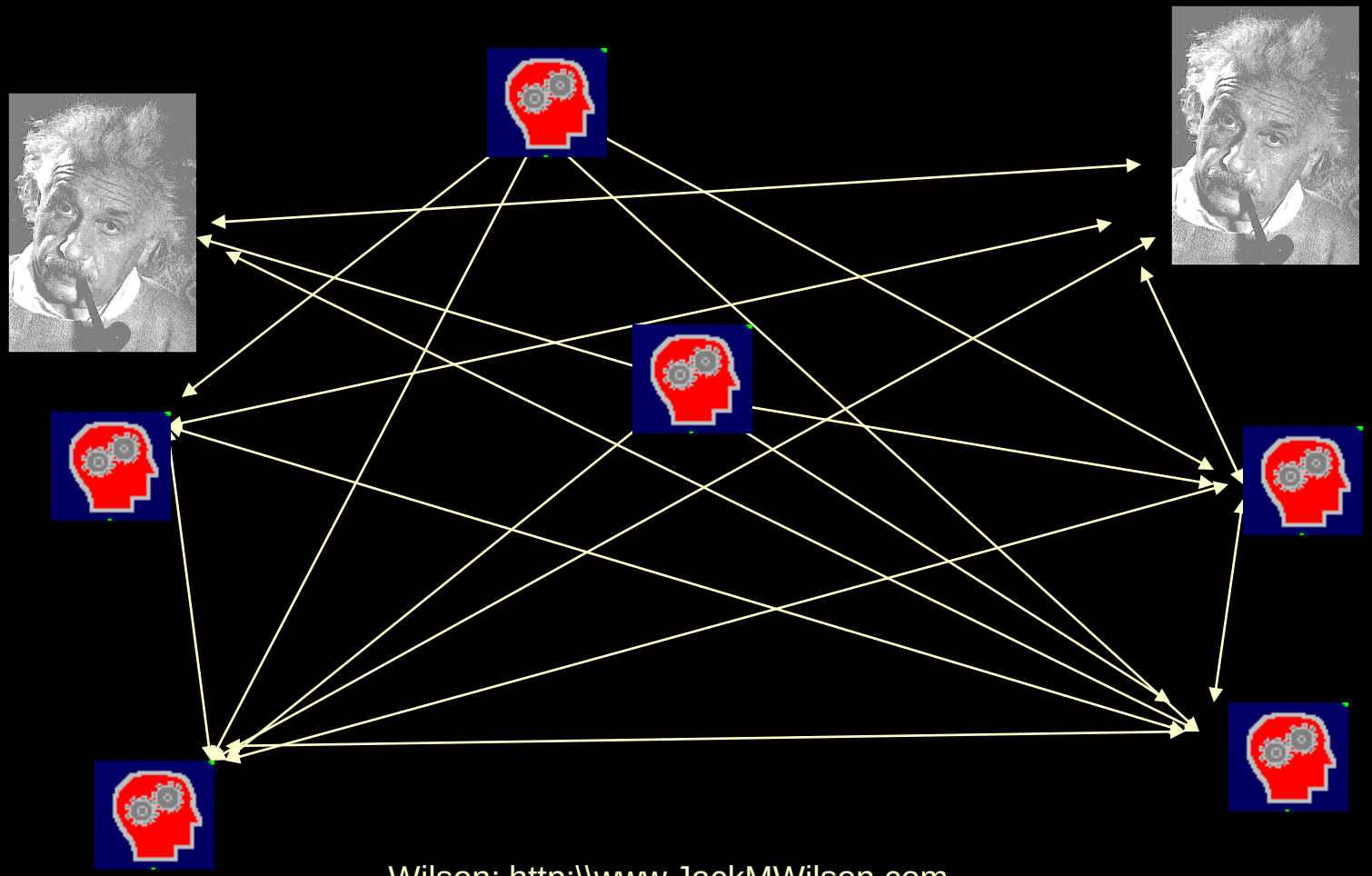

Wilson: http:\\www.JackMWilson.com

# Features of the Studio Courses

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

# The Studio Classroom

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

# The old model

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

# The New Model

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

# No more lectures

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

# No more books?

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- 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

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

# The Introductory Course

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750 - 1100 Students

Calculus (1100)

Physics (750)

Chemistry (650)

Intro. to Engineering Analysis (650)

Economics (~300)

(and now many advanced courses)

# The Introductory Course

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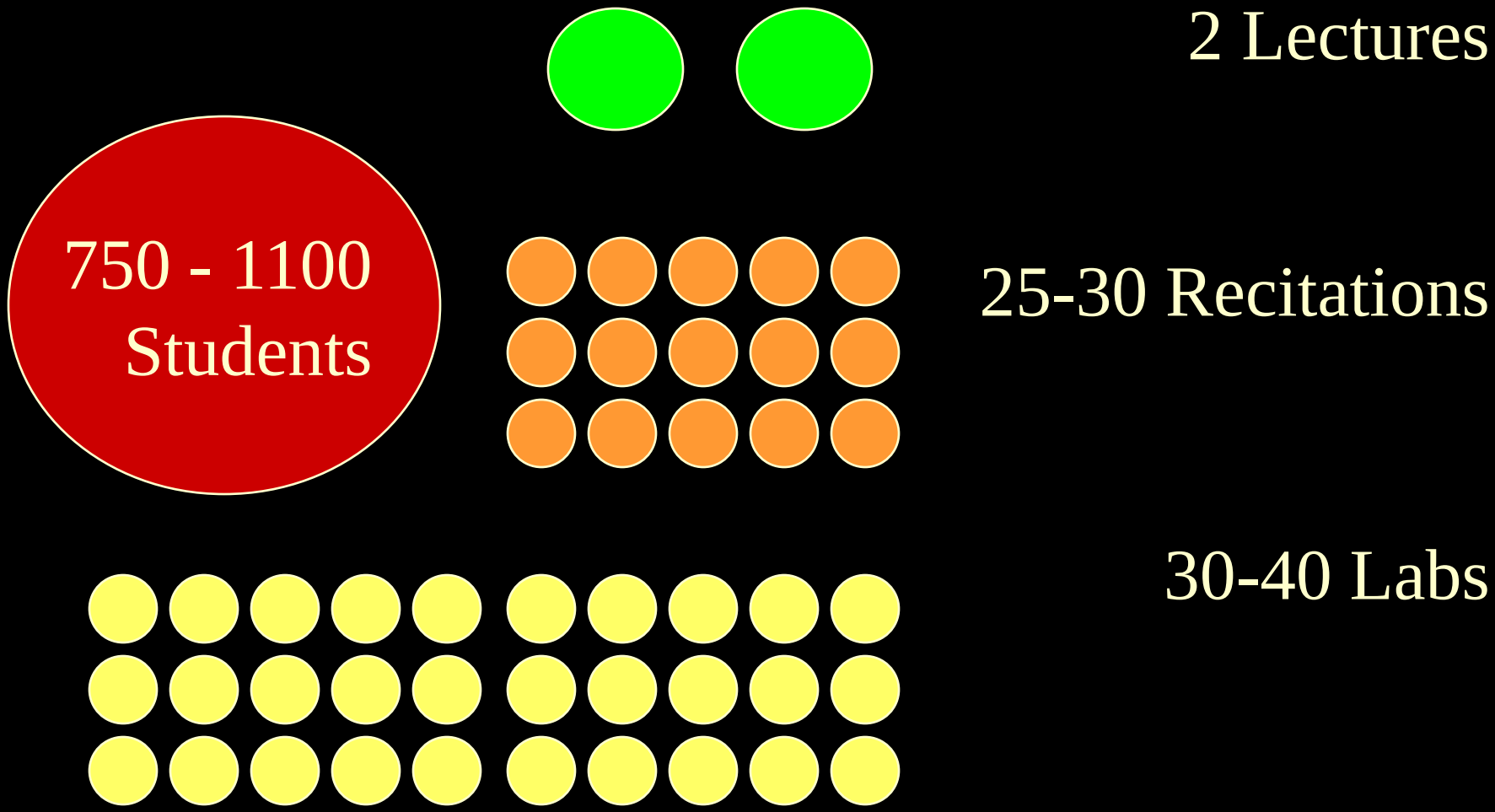

# The Introductory Course

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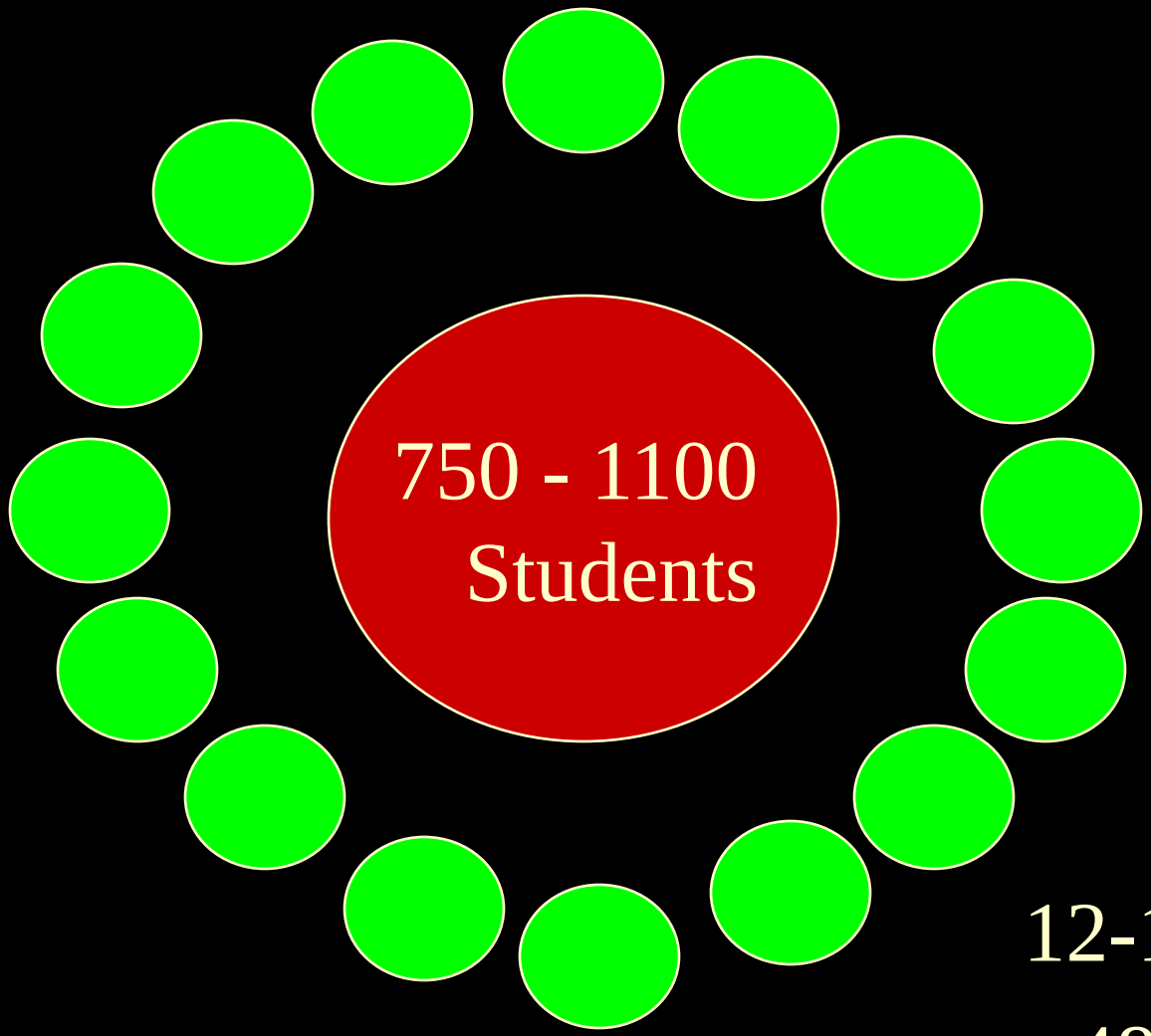


12-15 Studios

48-64 each

# The Traditional Classroom

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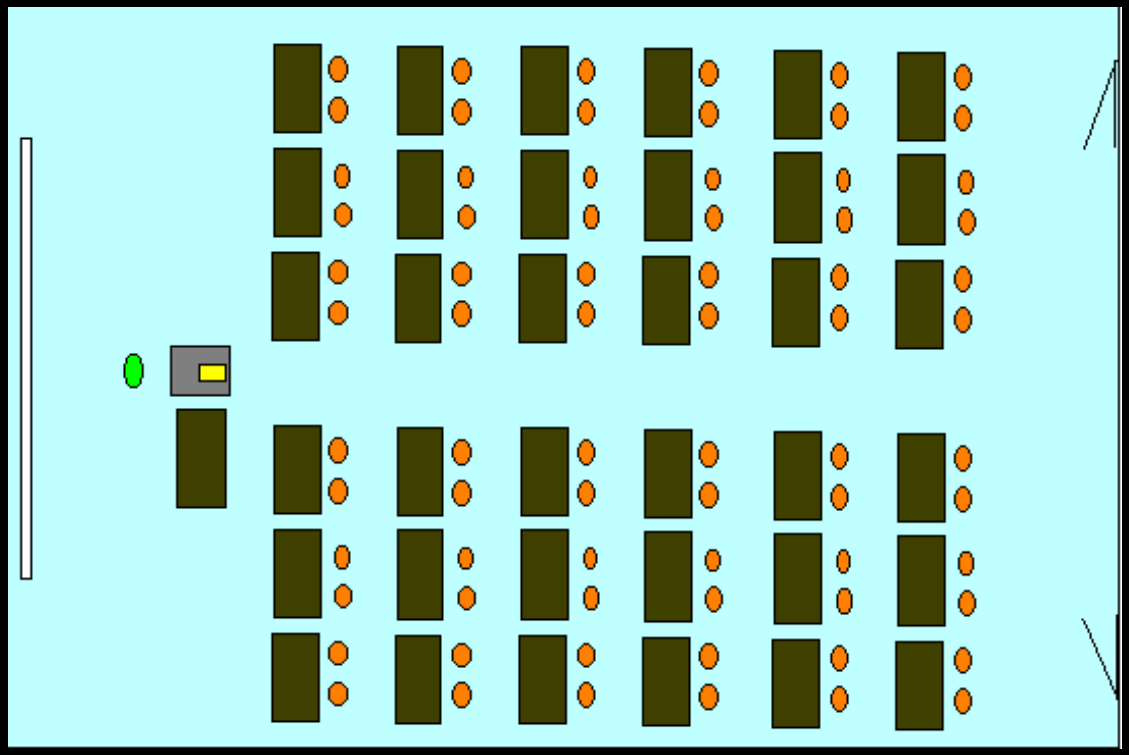

# The Studio Classroom

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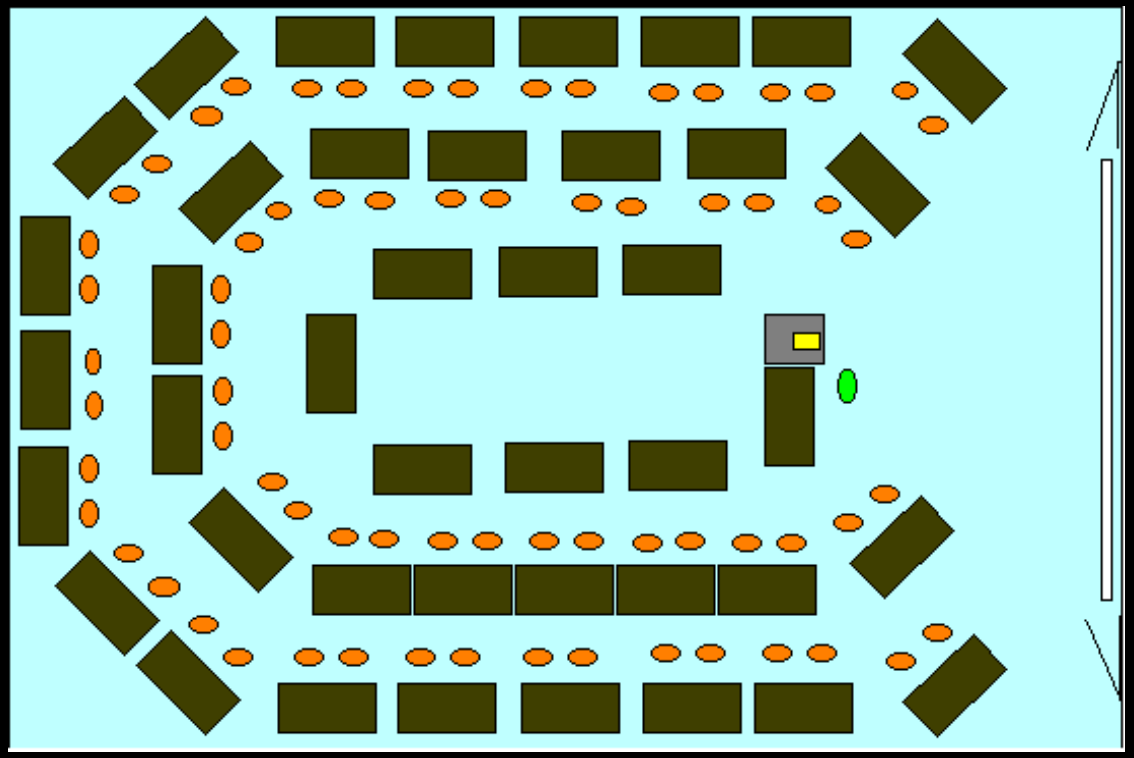

# The CUPLE Physics Studio

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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

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- (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

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

# How can we afford it?

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- 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

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

# Other Studio Courses

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

# Metrics

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- 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

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- 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

# The Studio at a Distance

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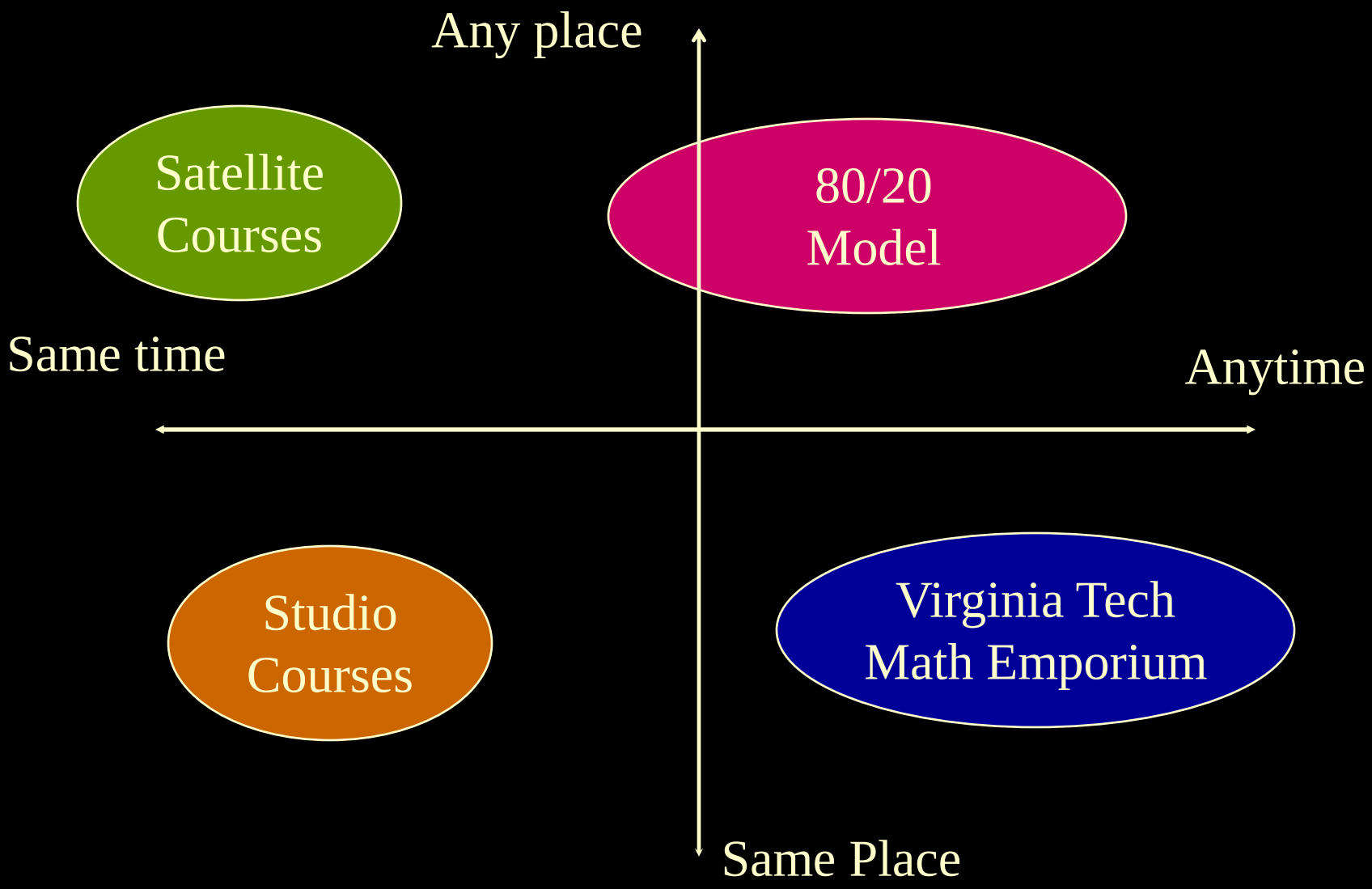

# Hands-On World Wide Web

- 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.

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- 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

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- 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

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**The End**

# 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.
6. Count on Moore's law ("What is hard today is easy tomorrow"). For example, computer processing 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.
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 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 )