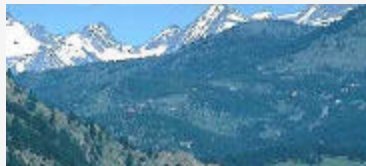





University of Colorado at Boulder

## Staying in Engineering: Impact of a Hands-On, Team-Based, First-Year Projects Course on Student Retention



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## Pipeline “Leakage”

- National engineering retention rate **50%\***
- CU-Boulder historic retention rates

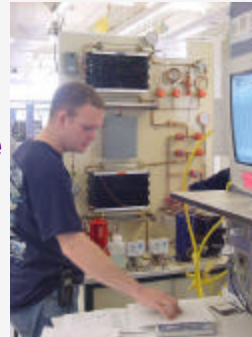
Overall 1986-96	<b>50%</b>
– Women	<b>52%</b>
– Latino	<b>41%</b>
– African-American	<b>41%</b>
– American Indian	<b>30%</b>



\* Source: Anderson-Roland, M.R. (1999) "The Effect of the Scheduling of the First Engineering Course on the Retention of Underrepresented Minority Engineering Students, ASEE Conference Proceedings, session 2570.

## Why Students Quit Engineering

- Poor teaching
- Lack of peer group support
- Confidence crushed
- Competitive engineering culture
- Huge class size
- Become “turned off” on the subject matter



Source: Seymour & Hewitt, *Talking About Leaving: Why Undergraduates Leave the Sciences*, 1997.

## First-Year Engineering Projects

- College-wide initiative
- 13 sections annually (max = 30 students)
- Hands-on interdisciplinary design teams
- Outstanding, student-focused teachers
- Cooperative, success-oriented culture
- Intro to the excitement of engineering
- Taught in limited-access design studios

***Engineering is about creating things for the benefit of society***

## Course Goals

- Introduction to engineering as a career
- Produce a team-based multidisciplinary product
- Experience the design/build process
- Experimental testing and analysis
- Communication skills (oral and written)
- Project management



## Course Components

- Social styles workshop
- Team dynamics exercises
- “Mini” design project
- Comprehensive design/build project



## Example Project Themes

- **Appropriate technology**
  - To better the lives of people in developing countries
- **Rube Goldberg contraptions**
  - Perform ordinary functions in surprising ways
- **Assistive technology devices**
  - e.g., page-turner for person with cerebral palsy
- **Interactive learning exhibits**
  - Teach engineering concepts to K-12 students
- **Autonomous Lego<sup>®</sup> robots**



## Design Expo

- Projects showcased at semester end
- External judges select section “bests”
- Peoples’ Choice Award



## Death by... Assessment?

- Pre/post skills self-assessments
- Peer assessments that count
- Student group interviews
- Faculty course questionnaire
- Retention analysis

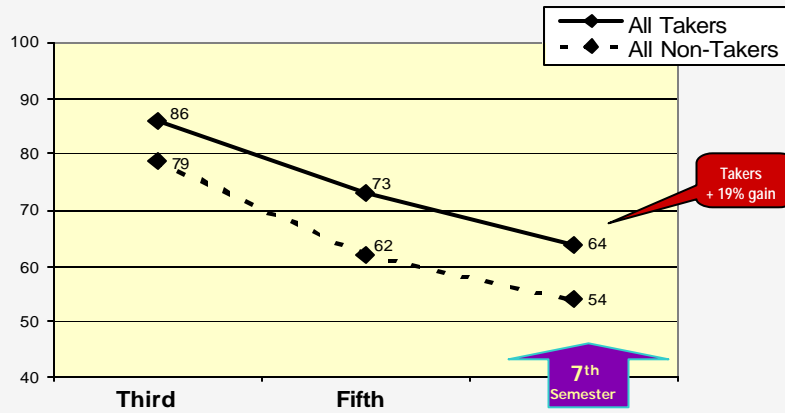


## Retention Study Demographics

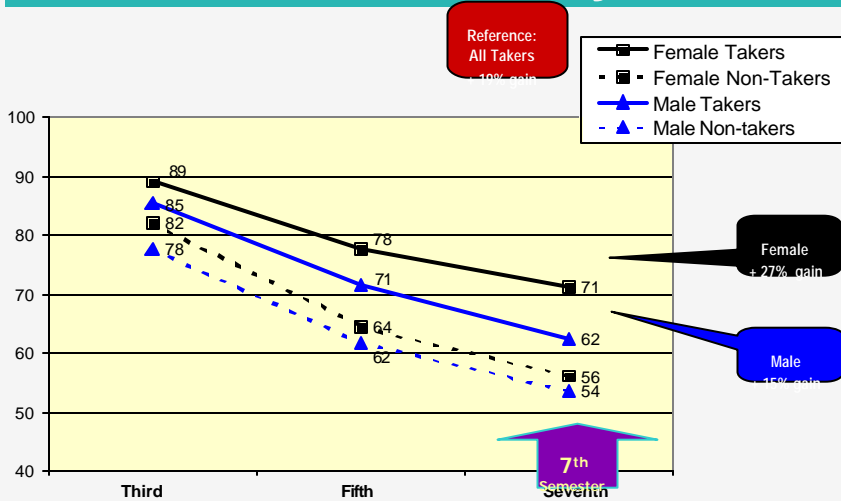
- AY 1994-1998 [5 years of data]
- N = 2,581 students
- Retention into senior year
- Course demographics
  - 40% “takers” (1,035); 60% “non-takers” (1,546)
  - Only included first-year “takers” (no transfers)
  - Gender: 80% males (2,057); 20% females (524)
  - Ethnicity: 80% Caucasians (2,063), 7% Asian (190), 6% Latino (160), 1% African-American (35)

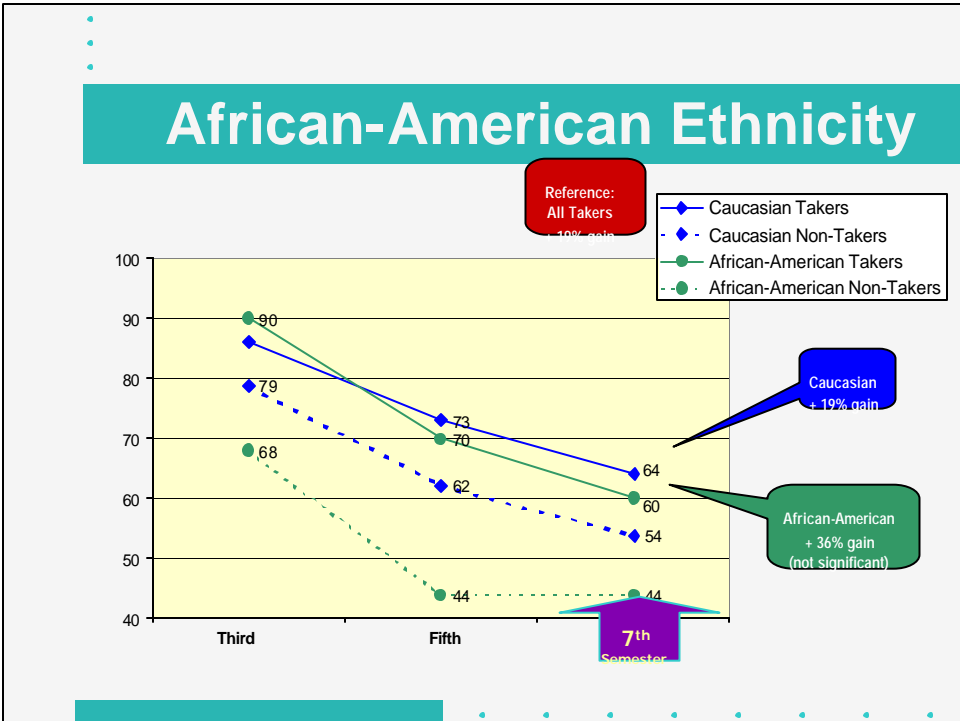
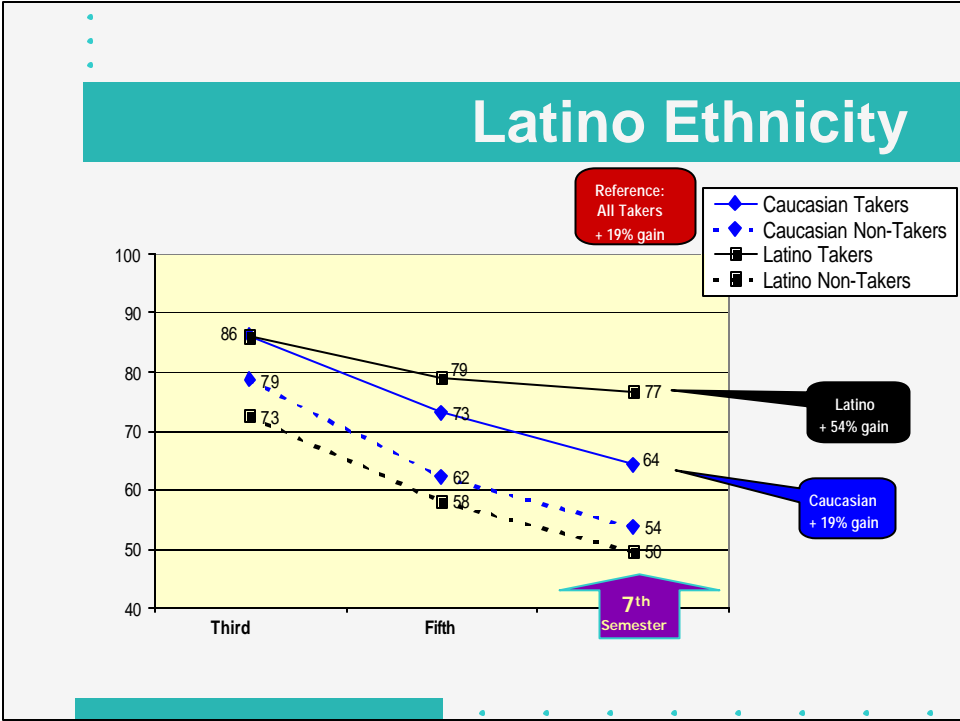


# Overall Retention



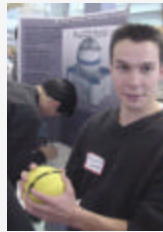
# Retention by Gender





## Overall Retention Gains

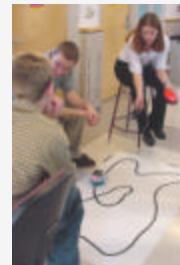
- All students: **+19%\***
- Women: **+27%\***
- Men: **+15%\***
- Caucasian: **+19%\***
- Latino: **+54%\***
- African-American: **+36%** (n too small for analysis)
- Asian: **+3%** (no significant difference)



\* Significant retention increase at  $p < .05$

## The Volunteer Effect

- Aerospace engineering students
- Required (n = 127) vs. volunteers (n = 94)
- Retention: 58% required; 64% volunteers
- No significant differences
- **Conclusion:**  
Retention affected by curriculum,  
not self-selection of student takers

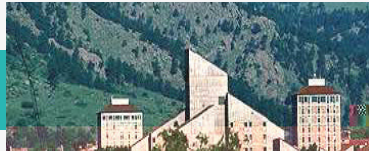


## Implications

- **Why not a college-wide first-year course?**
  - Cost of small sections
  - Some departments resist
    - Loss of control
    - Multidisciplinary focus
    - Usual lame excuses...
- **Cost of *not* implementing is also high**
  - Loss to the engineering profession and society
  - Loss of diversity
  - Negative perceptions of profession will persist



*Thanks!*



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