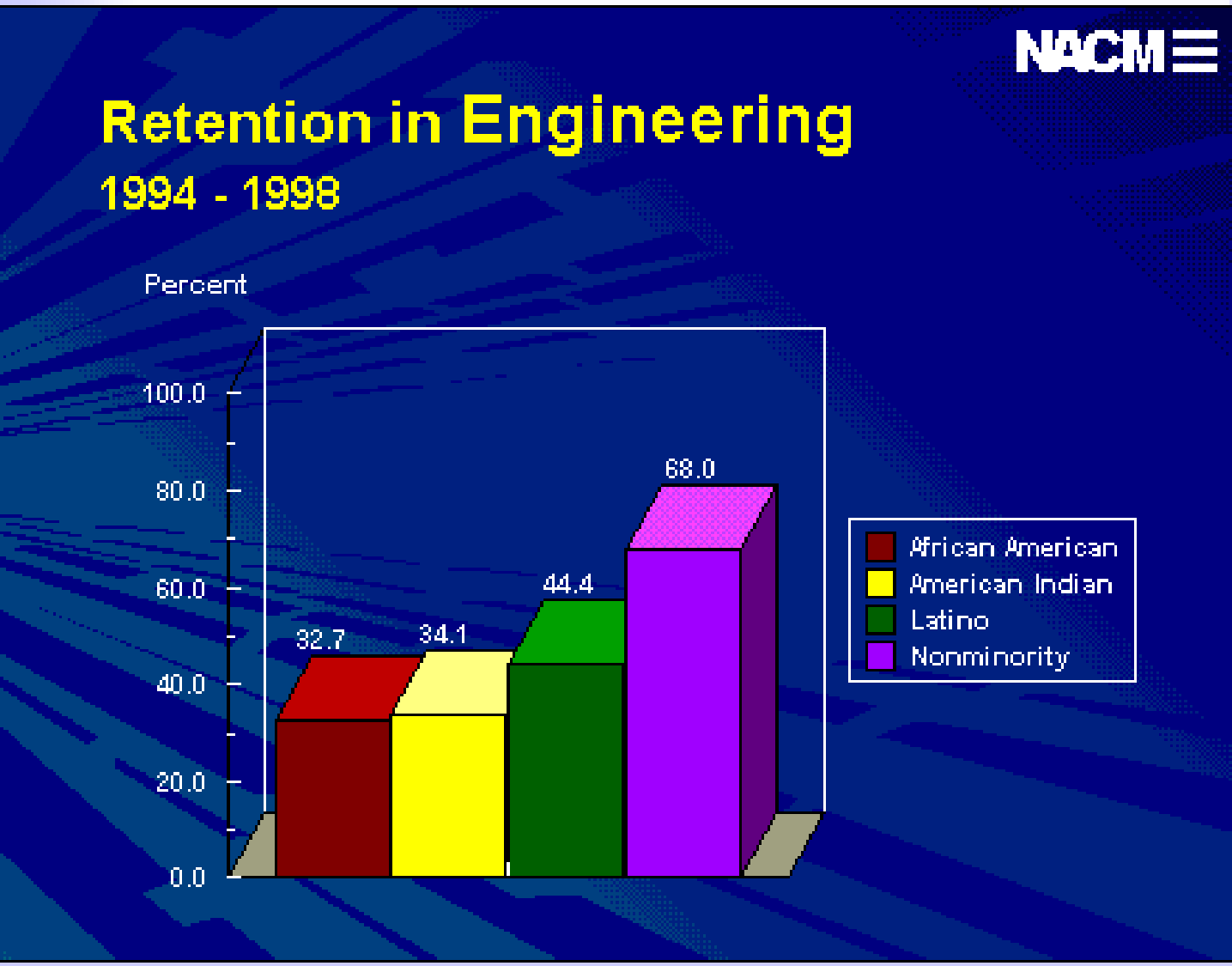
Retention of Undergraduate Students in Engineering

Karan Watson, Ph.D., P.E.
Associate Dean of Engineering and
Regents' Professor of EE

How are we doing now?

- Between 1990-1995 there was an average of 90,136 students entering the first-year of engineering programs (this excludes community college and undeclared students)
- Between 1994-2000 there was an average of 64,118 students graduating with BS degrees in engineering.



Who leaves the programs?

- Not necessarily the students with lowest SAT or ACT
- Not necessarily just students with low grades
- Not necessarily the least creative
- Many with strong leadership talents
- Greater proportion of women
- Greater proportion of minorities

Why do they say they are leaving: the literature

For student on 11 campuses who began college majoring in science, math, or engineering: % listing this concern (N=335)

	Switch	Stay
Poor teaching by SME teachers	90	74
Inappropriate initial choice	83	40
Inadequate advising or help	75	52
Loss of interest in SME	60	36
Other majors are more interesting	59	32
Curriculum overload, pace overwhelming	45	41
Rewards not worth the effort	43	20
SME career not condusive to lifestyle	43	21
Inadequate HS prep/study skills	40	38
Lost confidence due to grades	34	13
More appealing non-SME career	33	17
Financial problems to complete SME	30	23
Morale undermined by competitive culture	28	9
Conceptual difficulty with SME subject(s)	27	25
Lack of study group support	17	7
Found of aptitude for non-SME subjects	12	5

Elaine Seymour

Revisitng the "Problem Iceberg": Science, Mathematics, and Engineering Students Still Chilled Out-

Journal of College Science Teaching, May 95

Has anything changed

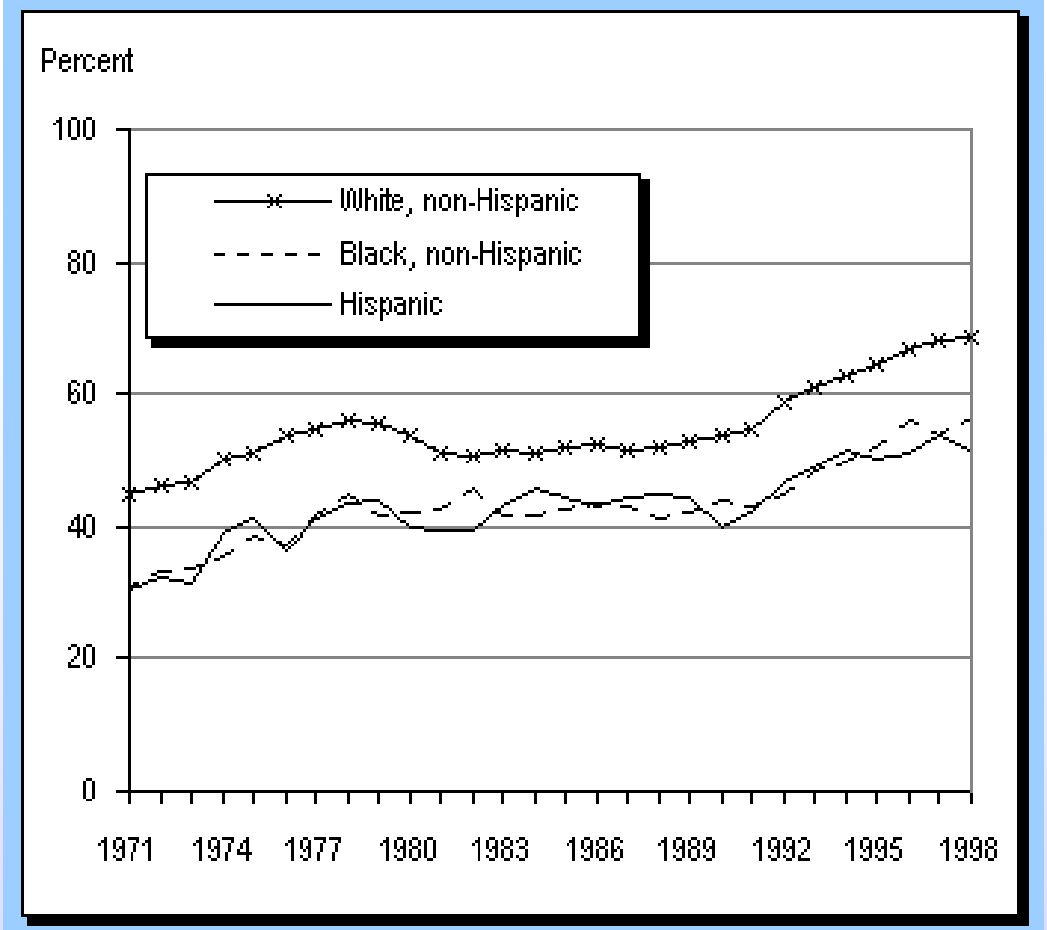
2. Grace Kelly, Elvis Presley, Karen Carpenter, and the E.R.A. have always been dead.
4. Somebody named George Bush has been on every national ticket, except one, since they were born.
7. A "45" is a gun, not a record with a large hole in the center.
10. *MASH* and *The Muppet Show* have always been in re-runs.
12. They have always bought telephones, rather than rent them from AT&T.
13. The year they were born, AIDS was found to have killed 164 people;
15. Wars begin and end quickly; peace-keeping missions go on forever.
16. There have always been ATM machines.
18. We have always been able to receive television signals by direct broadcast satellite.
22. They have never referred to Russia and China as "the Reds."
23. Toyotas and Hondas have always been made in the United States.
24. There has always been a national holiday honoring Martin Luther King, Jr.
26. Around-the-clock coverage of congress, public affairs, weather reports, and rock videos have always been available on cable.
28. Women sailors have always been stationed on U.S. Navy ships.
29. The year they were born, the *New York Times* announced that the "boom in video games," a fad, had come to an end.
37. Woodstock is a bird or a reunion, not a cultural touchstone.
40. Hurricanes have always had men's and women's names.
42. "Coming out" parties celebrate more than debutantes..
47. They have never used a bottle of "White Out."
48. If they vaguely remember the night the Berlin Wall fell, they are probably not sure why it was up in the first place.
49. "Spam" and "cookies" are not necessarily foods.
50. They feel more danger from having sex and being in school, than from possible nuclear war.

Beloit College- Mindset List

High School Completers with Some College

Figure 1-2.

Percentage of 25- to 29-year old high school completers with some college, by race/ethnicity: 1971–98

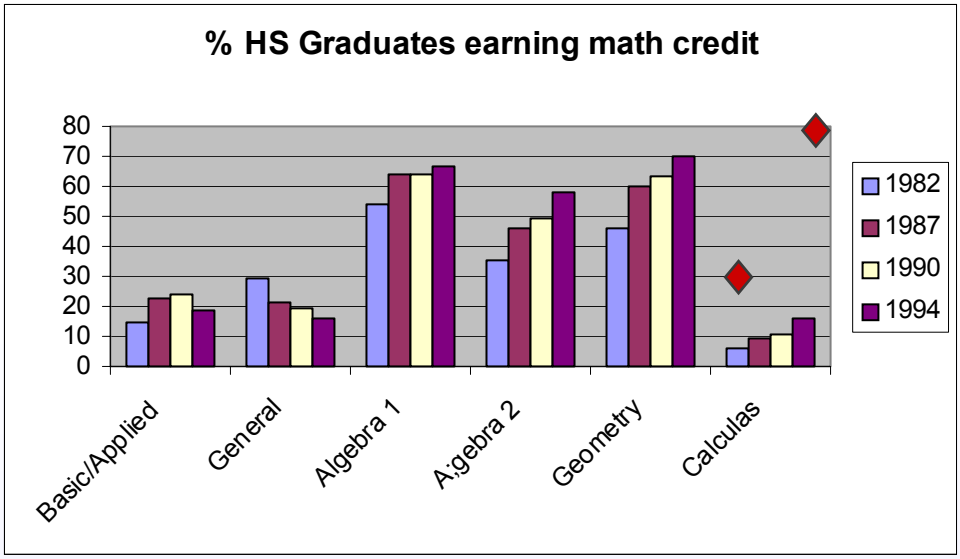


SOURCE: U.S. Department of Commerce, Bureau of the Census, March Current Population Surveys, various years.

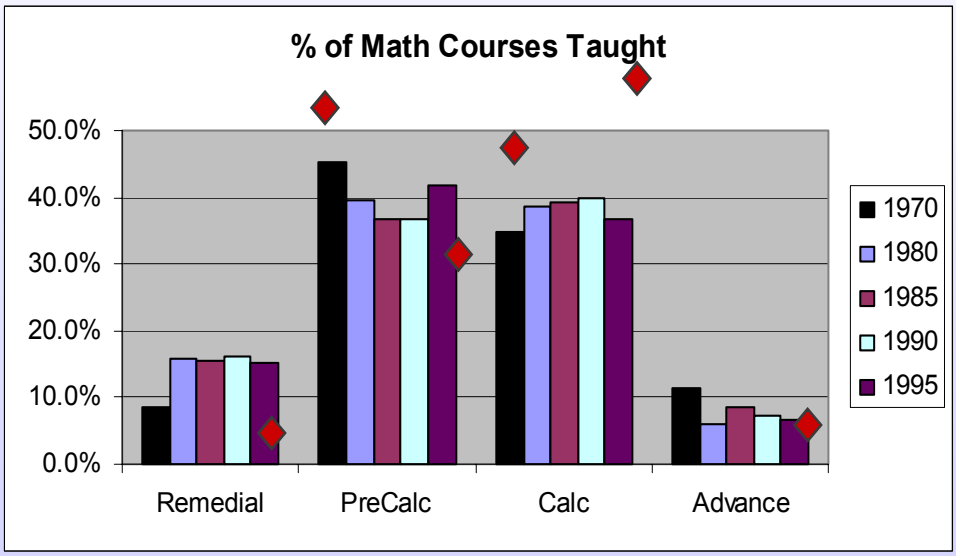
Women, Minorities, and Persons With Disabilities in Science and Engineering: 2000

- In the last 30 years we went from ~42% of HS graduates attending some college to ~65%

Change in math patterns

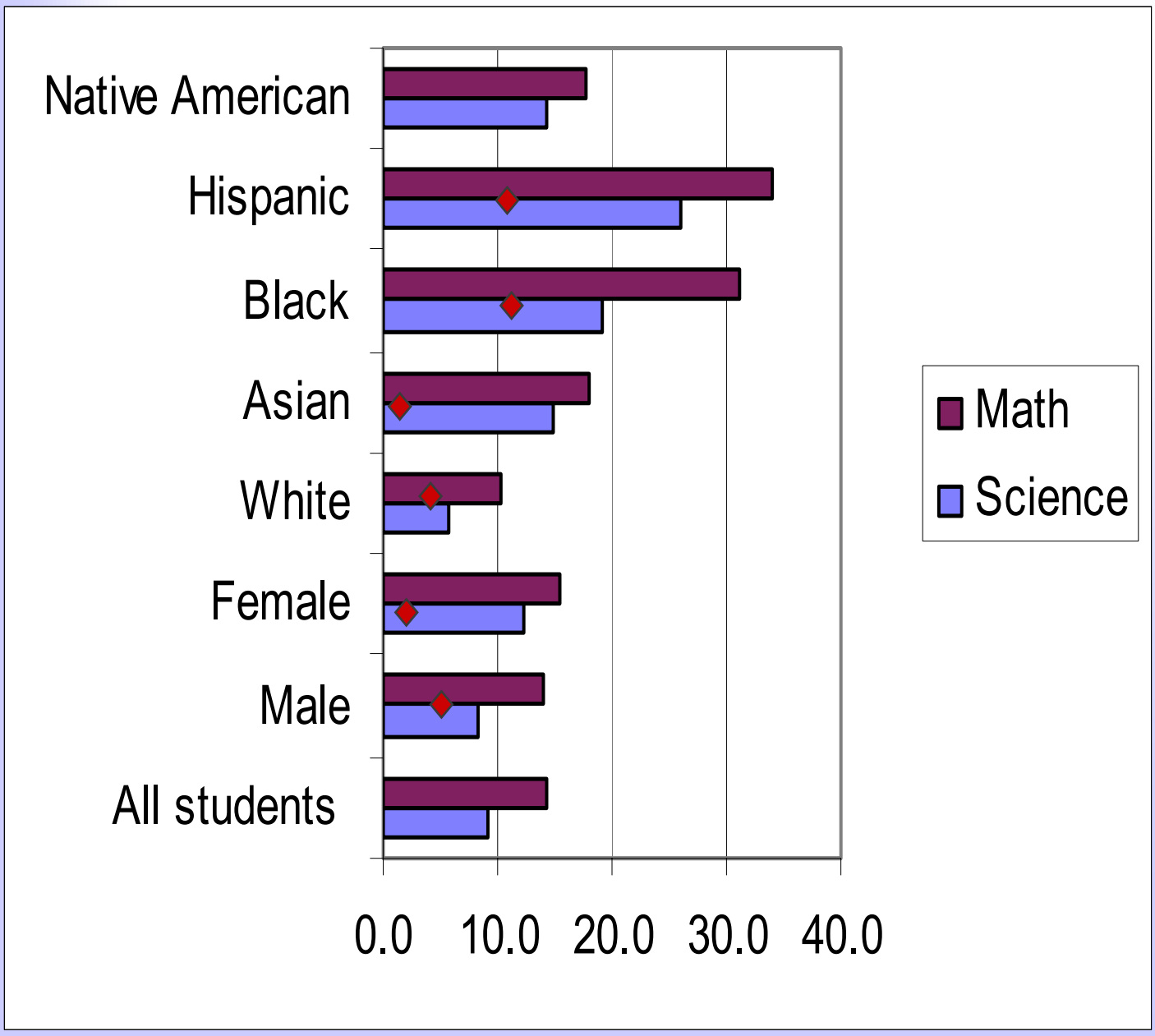


Good news: more students in college prep maths



News: more students need remedial math,
And less are ready for college calculus

Freshmen Students in Engineering Needing Remedial Work in Science or Math (1995)



What retention problem are you working on

- More engineering graduates
- More diverse engineering graduates
- Better engineering graduates
- Possibly more and more diverse incoming students

- All require more work

Issues for TAMU engineering retention in 1994:

- The University (who decides new student admissions) wanted us to have a greater number of incoming students, both new high school grads and transfer students, and they would not increase our resources to teach more in upper levels. (We are a good recruiting mechanism for the rest of the University). The only filter we have is on who gets into upper level by using GPA.
- We wanted women and minority retention to be at least as good as other groups in the college, and it was not.
- We wanted to be sure that 'good' students persisted. Our data showed more students exited for reasons other than grades than we desired.

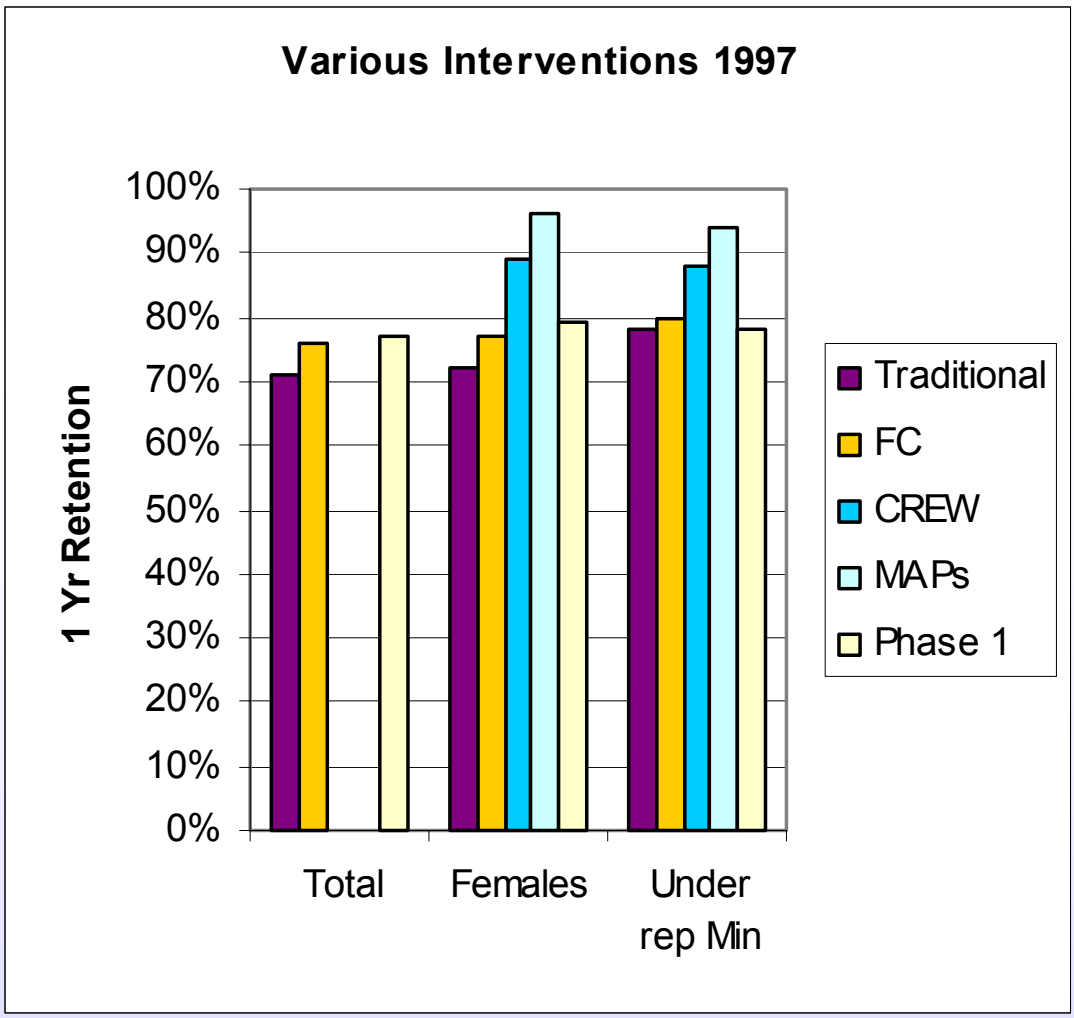
Adapting the Learning Environment

Plan at TAMU


Early context and reality
Industry Participating
Integrated materials and faculty
Meaningful Design Projects
Technology & Labs
Engineering early
Independent
Random Groups
Organized Groups
Communities
Inclusive Communities
Better community of learners
Better Teaching for Diversity
Organized For learners
Enthusiasm for material
Diverse Styles
Formative Evaluator

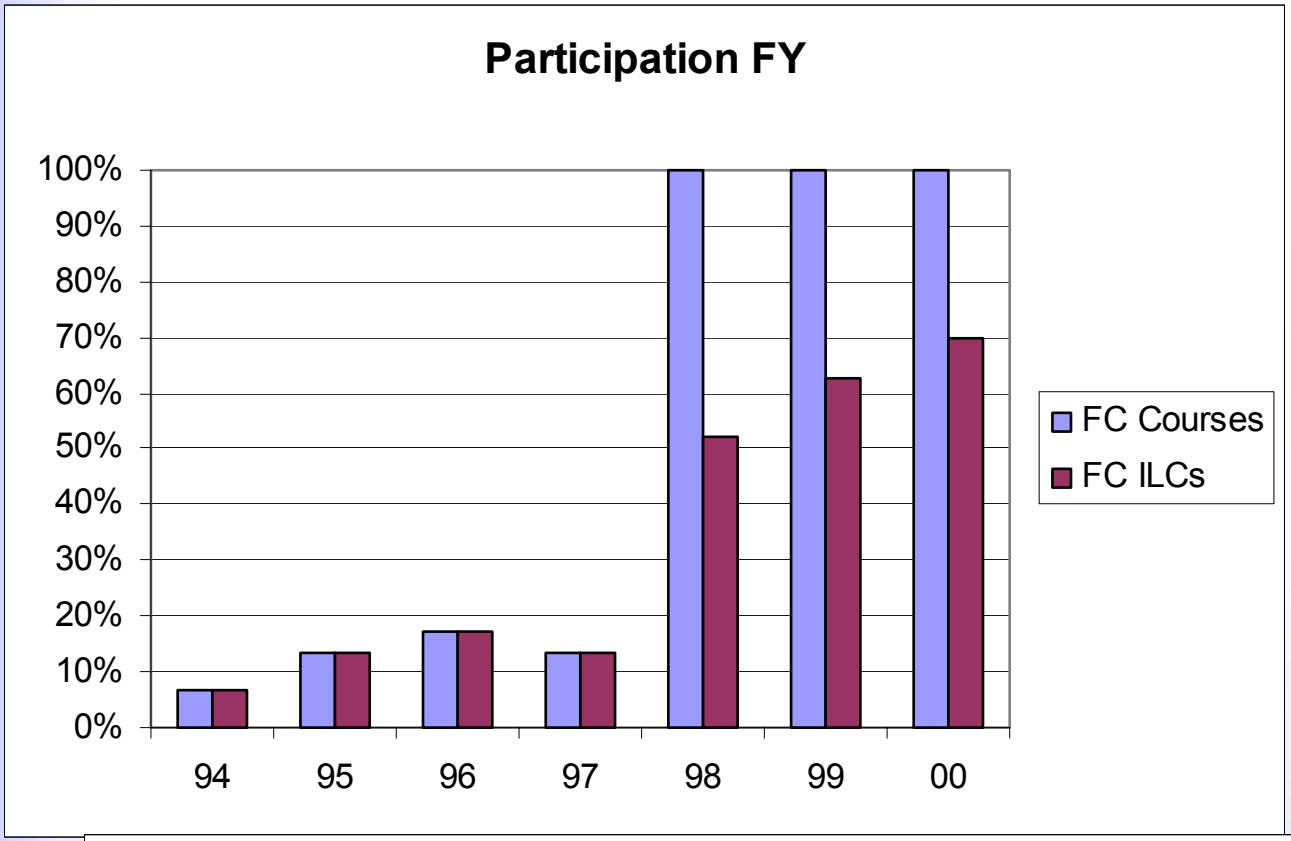
Change the Classrooms and Instruction Style

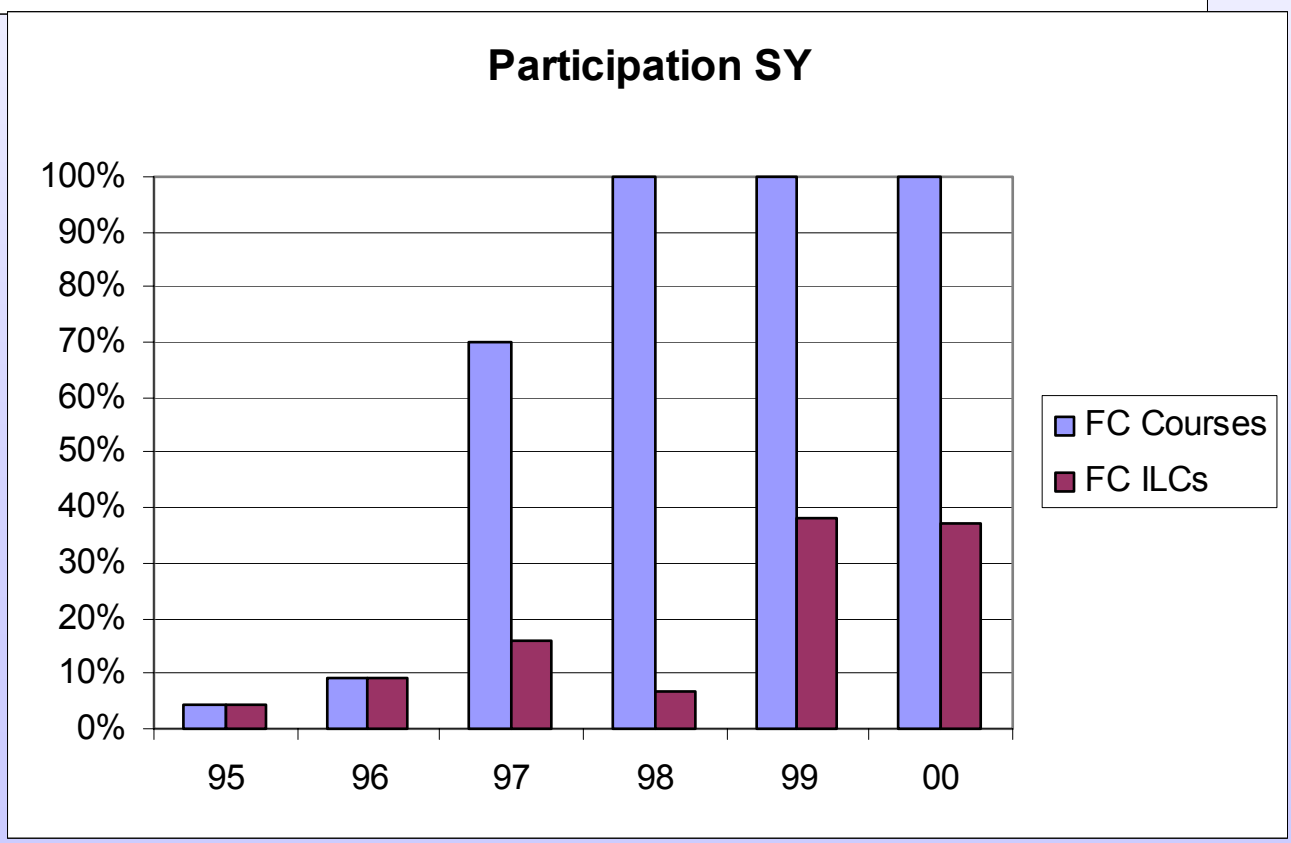
Various TAMU Interventions



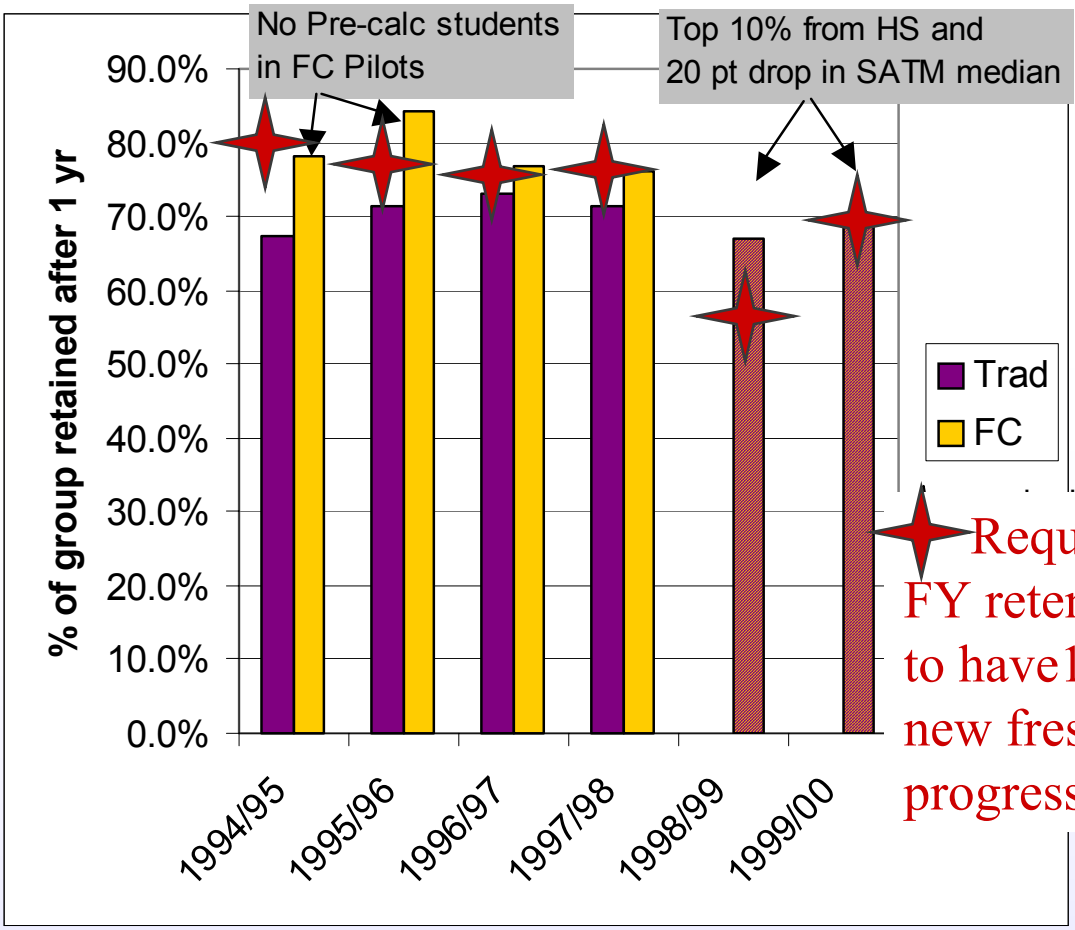
In 1997: Total for college was n=1265
Total for FC Integrated Courses was 230
Total for CREW Womens' 1 Yr Dorm Clusters was 65
Total for MAPs Women Student/Pro Mentoring was 85
Total for Phase 1 5wk summer students needing Math Remediation was 44

Participation in FC





Examples of Texas A&M Engineering Data

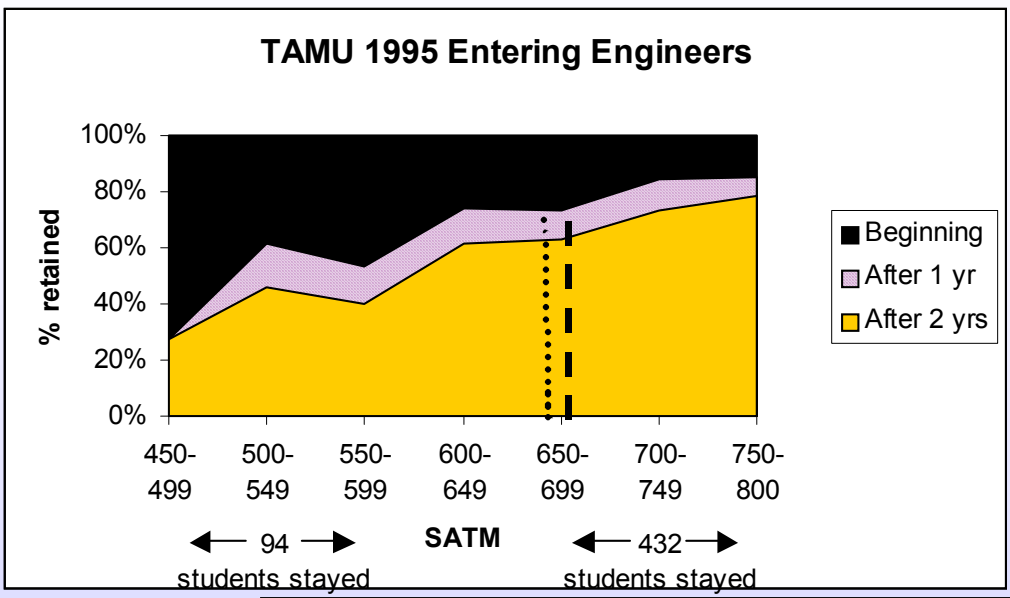


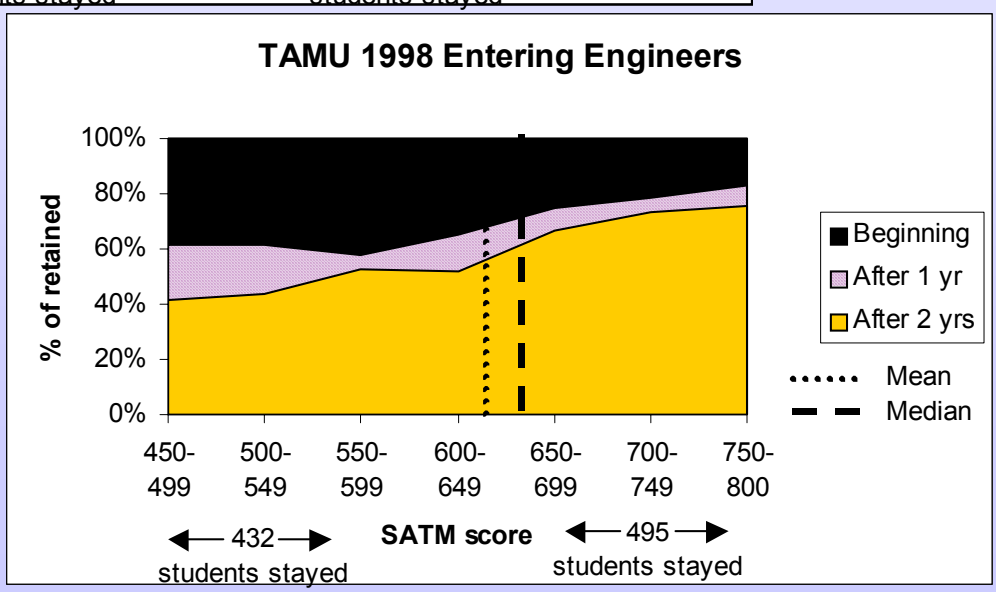
In 1994:
Women's 1st yr retention was 3% lower than men's
And Underrep min. was 6% lower than non-minorities

In 1999:
Women's 1st yr retention was 1% higher than men's
And Underrep min. was 2% higher than non-minorities

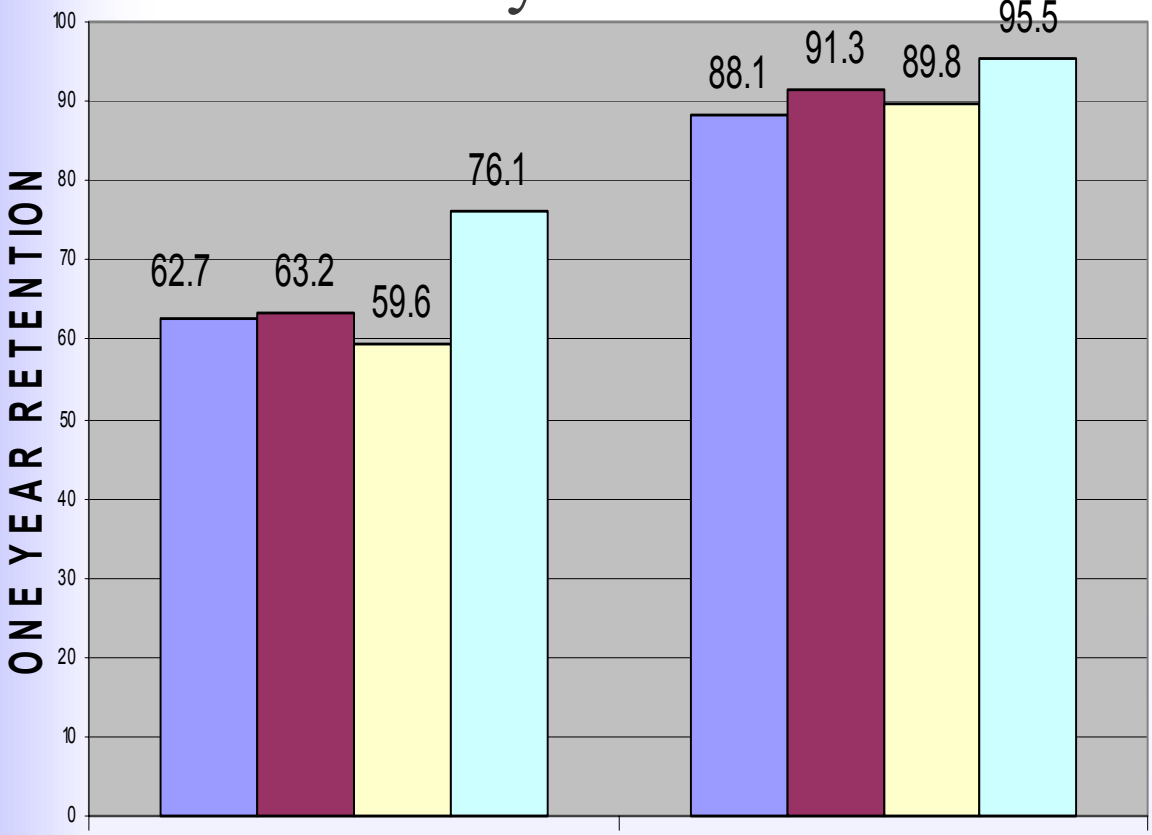
Target retention of larger group of low SATM

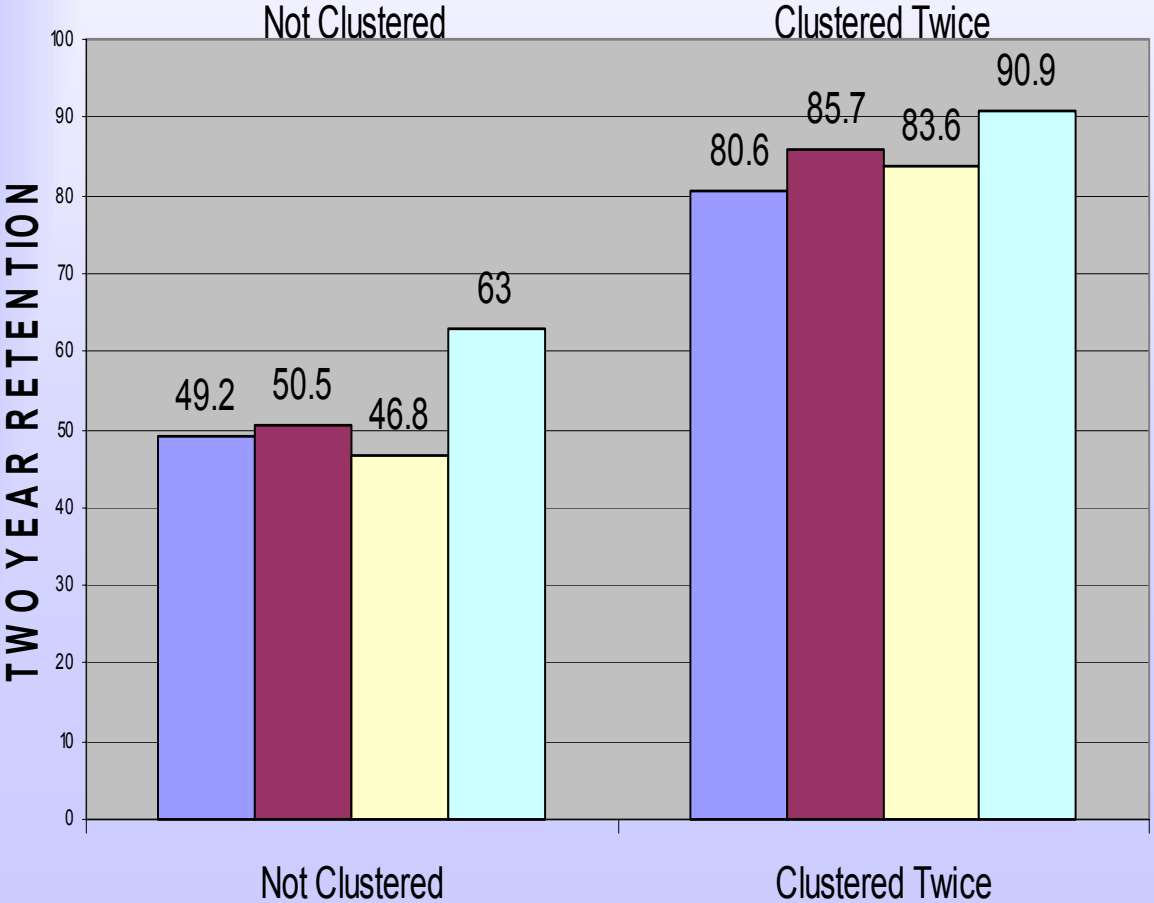
- Beginning in 1998 the State of Texas decided that all top 10% HS graduates must be admitted to major of choice.
- At TAMU SATM and SATV accounts for ~10% of GPA variance, and HS rank accounts for ~28% of GPA variance



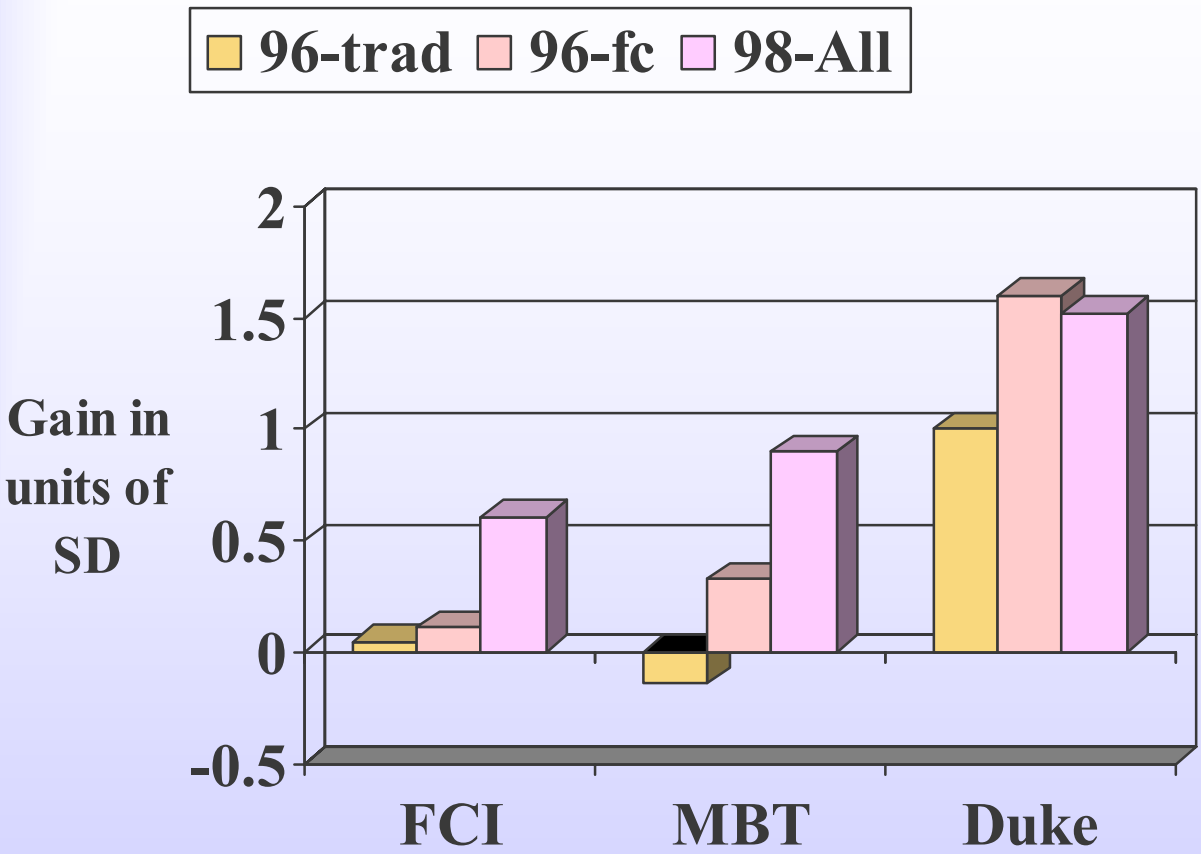


On average, students in the clusters are one and two year retention is better

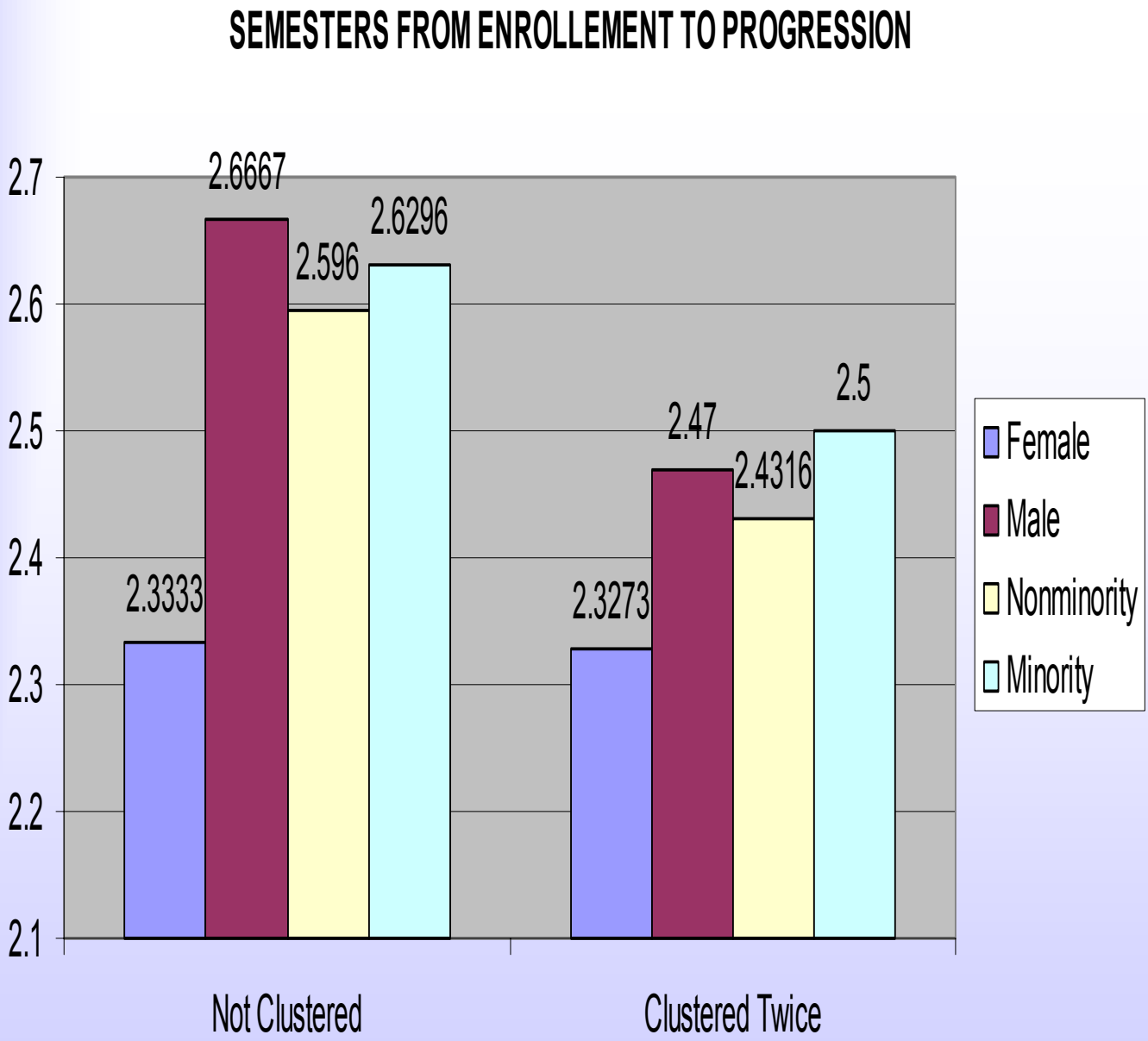




Gains in conceptual understanding of force concepts (FCI), mechanics concepts (MBT), and calculus concepts (Duke) for first-year students.

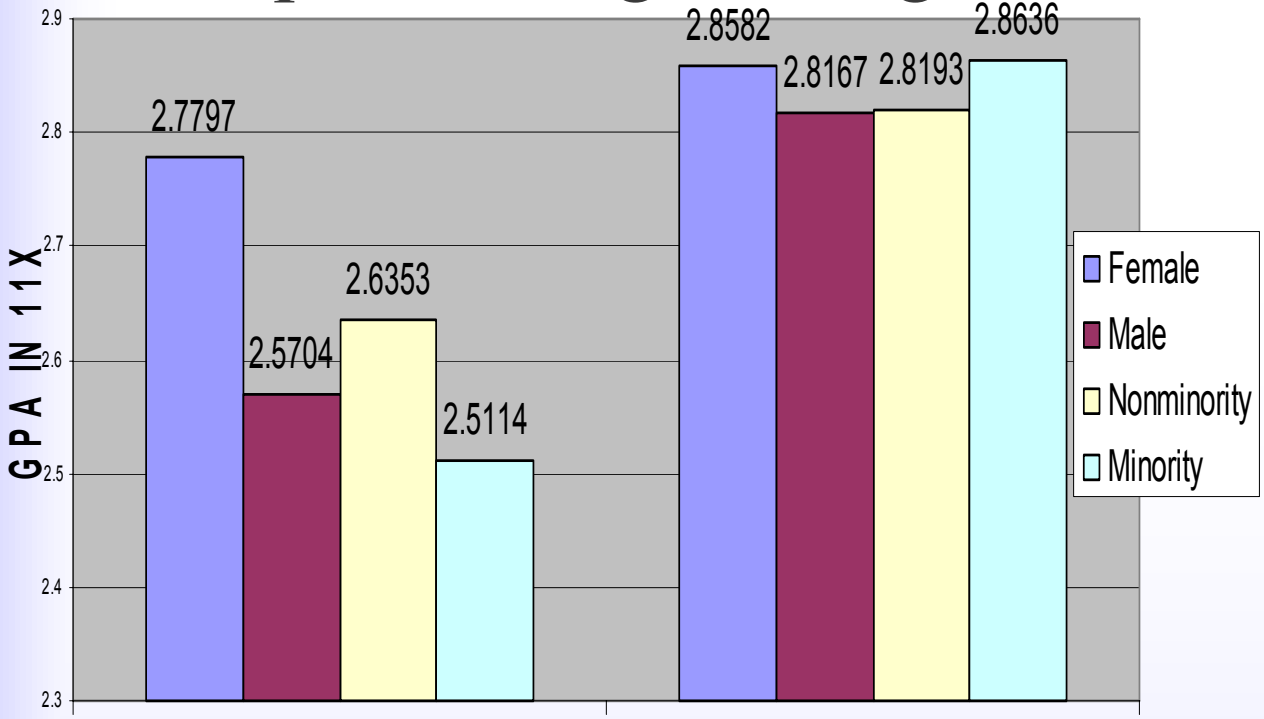


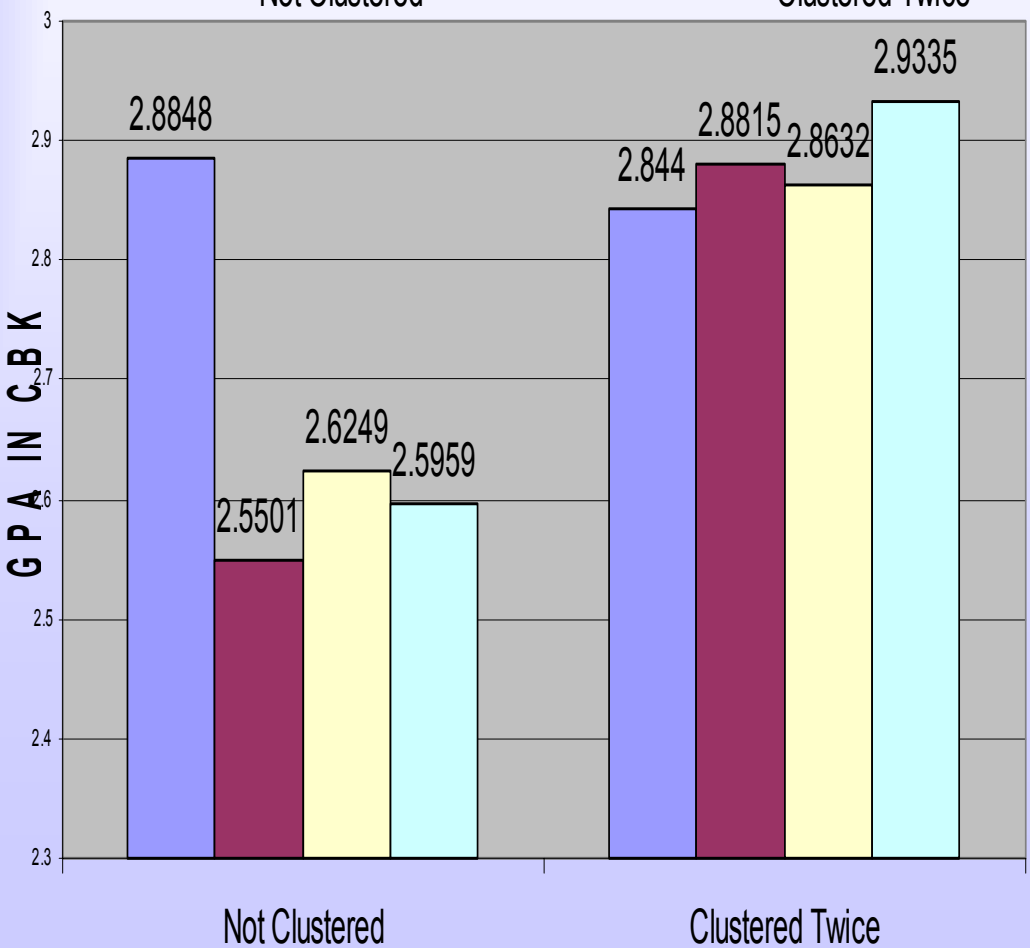
On average, students in the clusters are finishing CBK faster



All Statistically significant except female

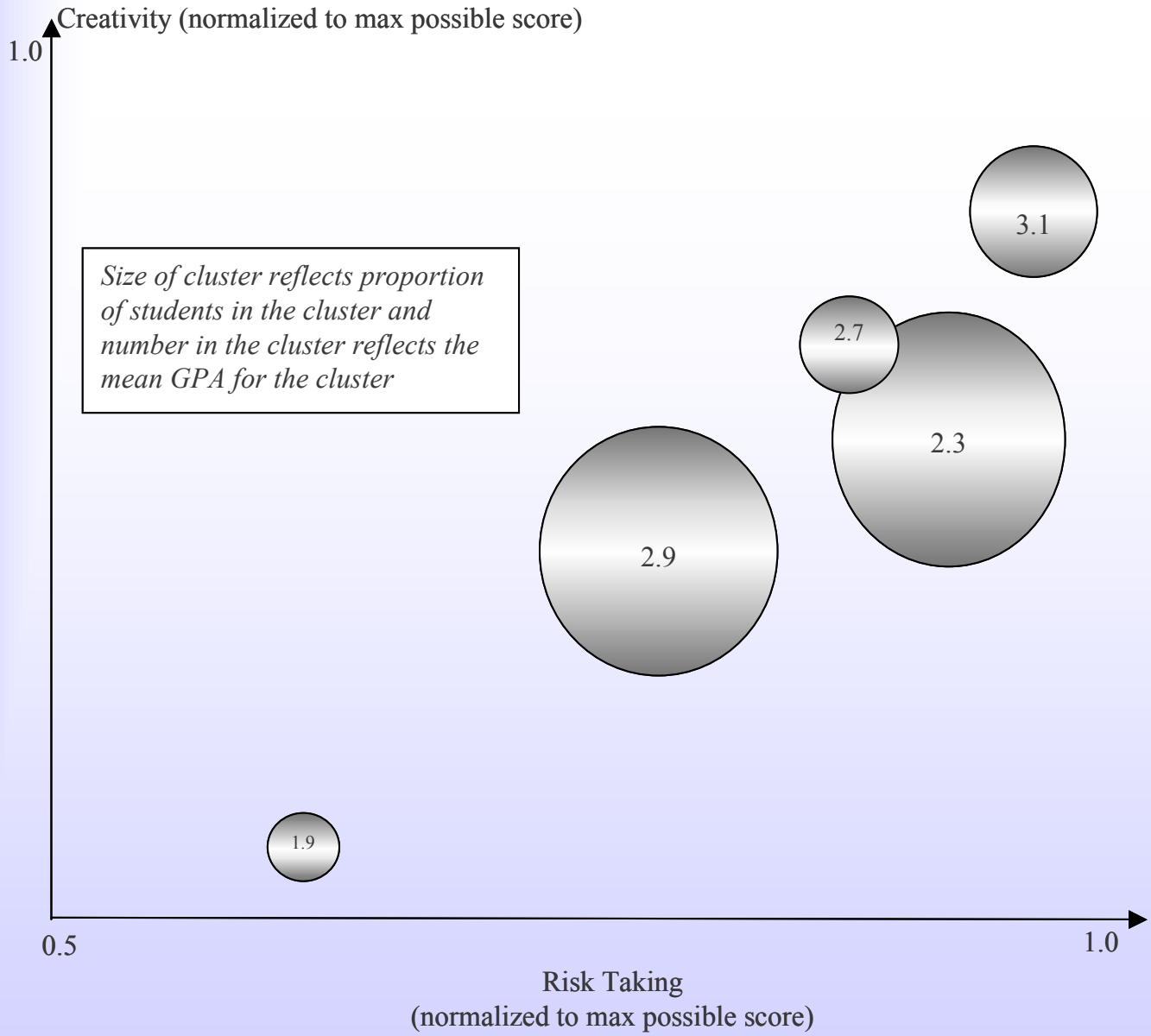
On average, students in the clusters are performing better grade wise





All stat. sig. except female

Interesting Observations for Classroom Changes



Factors are

ACL-active and collaborative learning,

TEE-Technology enhanced education,

INT- course integration

- Total Retention ACL=INT>>TEE
- Female Retention ACL>INT>>TEE
- Male Retention INT>ACL>>TEE
- Minority Retention ACL>INT>>TEE

- Physics Concepts & Grades ACL>INT>>TEE
- Calculus Concepts and Grades TEE>INT>>ACL