Highlights of
2010 IUPUI Assessment Conference Presentation "Using CIRP Surveys to Assess and Improve the First-Year STEM Experience "

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Presentation Take-Aways

- Framework for freshman retention using the CIRP Freshman Survey
- Research findings for freshman year at the University of Michigan
- How engineering student success is different
- Role of assessment in a continuous improvement cycle for STEM majors
- Implications for pedagogy, curriculum and working with K12 educators

Literature References

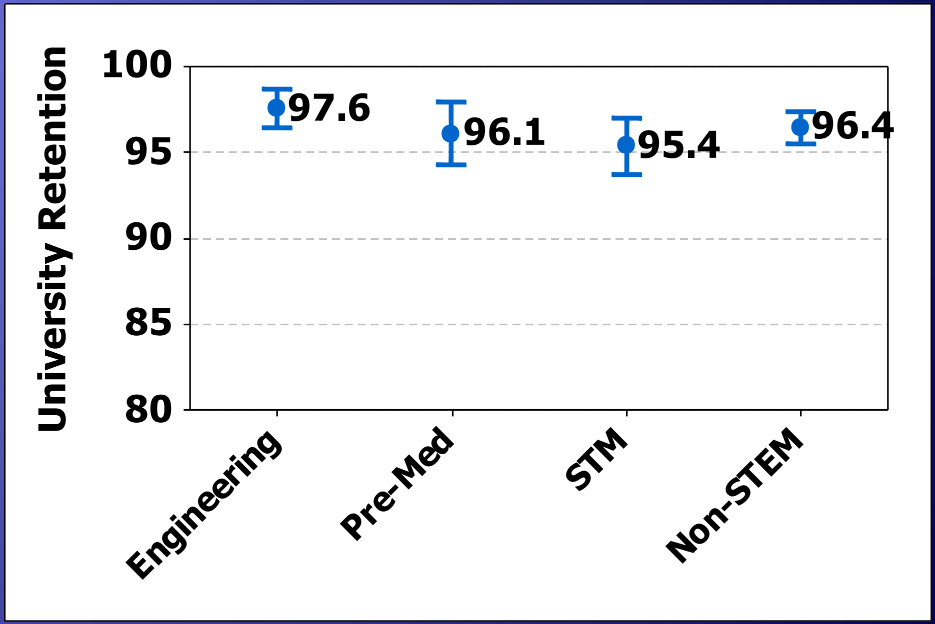
- Veenstra, Dey and Herrin, "A Model for Freshman Engineering Retention" *Advances in Engineering Education*, 2009
- Veenstra, Dey and Herrin, " Is Modeling of Freshman Engineering Success Different from Modeling of Non-Engineering Success?", *Journal of Engineering Education* , 2008.
- Veenstra, *Modeling of Freshman Engineering Success*, dissertation, University of Michigan, 2008

Articles available at http://www.veenstraconsulting.com/publications.php
Dissertation available at http://deepblue.lib.umich.edu/handle/2027.42/58391

Four Freshman Student Sectors:

No Significant Difference in First-Year University Retention

Great success with retention: Why? What are the pre-college predictors for first year GPA and retention, and especially for engineering?



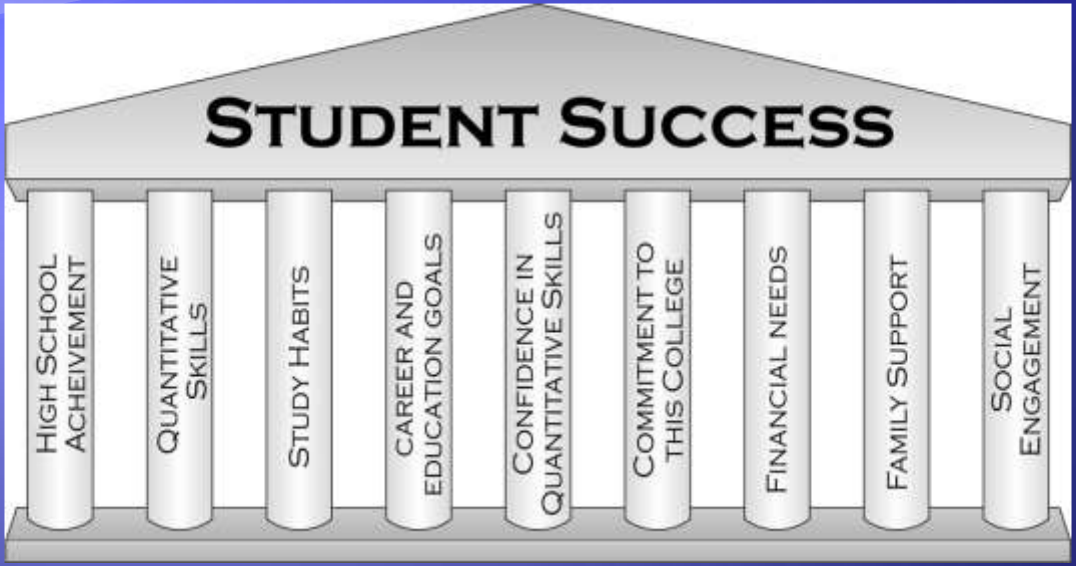
2004& 2005 Freshman Classes

Source: *Modeling Freshman Engineering Success*

5-Step Assessment Process

1. Establish a Model for First-Year Success-included Nine pillars for student success
2. Identify CIRP and admissions variables for each pillar, including 51 CIRP variables
3. For each pillar conducted a factor analysis and developed 19 factors
4. Conduct regression analyses on First-Year GPA and First-Year retention on each sector
5. Make conclusions and improve strategies

Nine-pillar Framework for Freshman Retention Assessment



Based on research literature from higher education research and engineering education research

A Model for Freshman Engineering Retention , *Advances in Engineering Education, http://advances.asee.org/*

Predictors (P) of 1st-year GPA

Pillar with significant factor	Engin	Pre-Med	STM	Non-STEM
H.S. Academic Achievement	P	P	P	P
Quantitative Skills + Interaction	P			
Confidence in Quantitative Skills	P			
Career Goals	P			
Financial Needs			P	
Study Habits			P	
Social Engagement		P	P	P
Adjusted R2	0.38	0.15	0.27	0.26
Sample Size	184	100	145	206

See JEE article, 2008, Veenstra, Dey & Herrin for details **P-significant at p<.05**

Predictors (P) of 1st year University Retention

Variable	Engin	Pre-Med	STM	Non-STEM
First Year GPA		P	P	
High School Rank	P			
Concern about Finances	P			
Sample size	705	433	626	1490

Based on 2004 and 2005 Freshman cohorts, University of Michigan
Source: Modeling Freshman Engineering Success , Chapter 7
http://deepblue.lib.umich.edu/handle/2027.42/58391

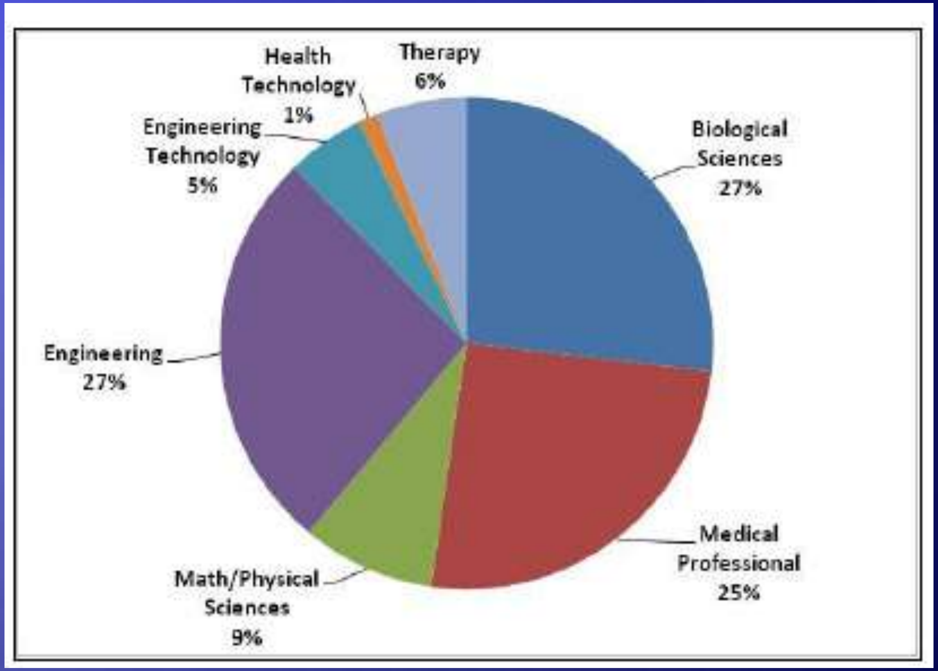
Conclusions

- No significant difference in retention rates
- Predictors for Engineering student success are different
- Non-Engineering STEM students modeled more like Non-STEM students for academic success
- No significant difference in ethnicity (URM vs. non-URM) or gender for GPA or retention for any sector , once model is taken into account

Slides Developed for Presentation: Ideas and Implications for future policy on improving STEM graduation rates

Diversity of STEM: All STEM Are Not Alike!

- Each STEM sector may have different needs and different student support issues
- Important to include rational STEM groupings in assessments

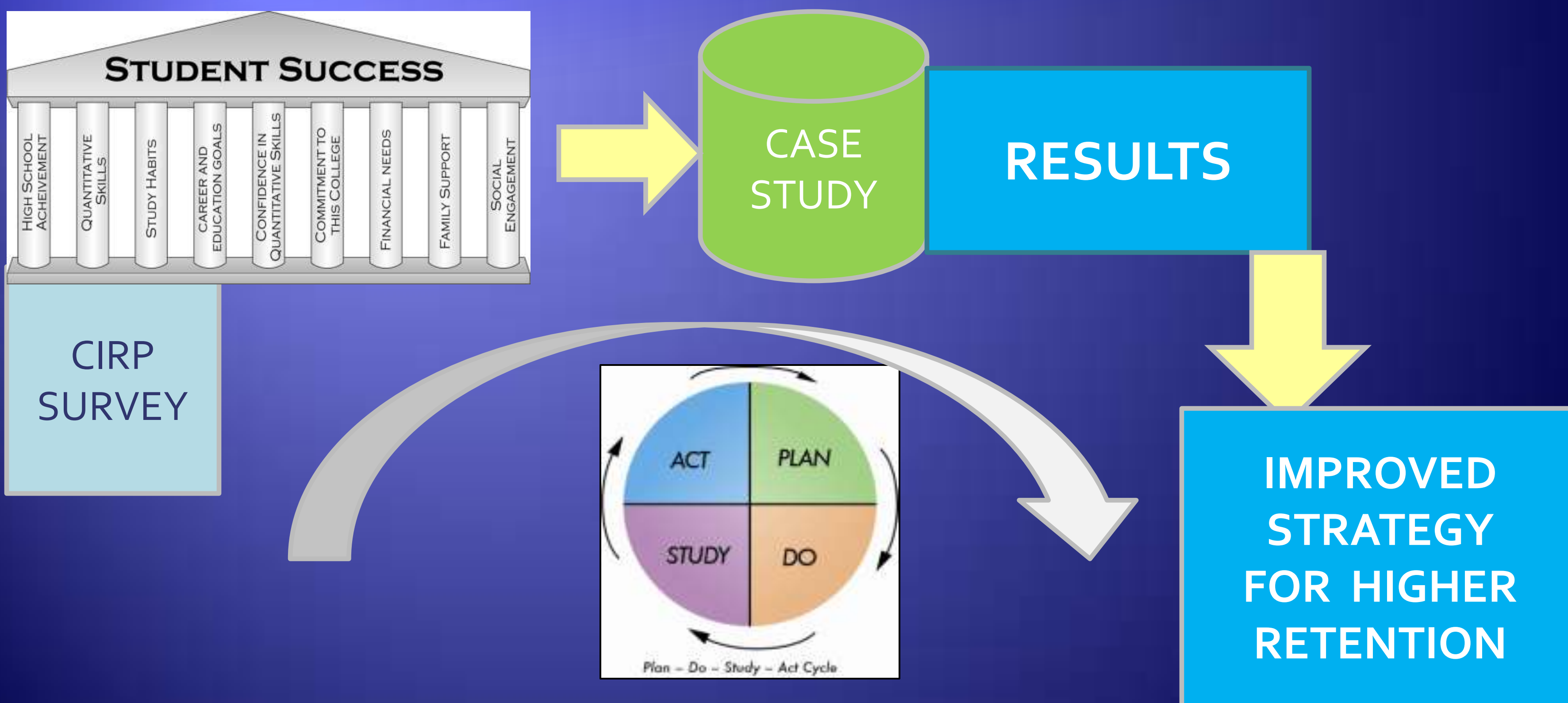


"The Diversity of STEM Majors", 2010, www.veenstraconsulting.com and "The American Freshmen National Norms", HERI, 2009.

Implications for Engineering

- Placement into appropriate math course is extremely important
- With the difficulty of the STEM courses and the number of them, a student-centered culture based on best practices in pedagogy is important for both student success and retention

Strategy for Research to Practice For First-Year STEM Retention



Continuous Improvement

Would the STEM graduation rate increase if we systematically practiced Plan-Do-Study-Act Continuous Improvement at all universities?

What are some ideas we should be considering to improve STEM graduation rates?

Policy-steering at the national and state levels have linked STEM student recruitment and preparation with workforce development and economic welfare

These linkages have to be juxtaposed with

1) **how to get students interested in STEM type of activities, information, and courses; and**

2) **getting students to think of STEM as a career choice.**

What the data reflect is the need to focus more on student recruitment activities prior to students coming to the university

- This suggests that in addition to increasing the number of students taking AP or IB STEM courses (*Rising Above the Gathering Storm, Revisited*, 2010, recommendation A-3-1, p. 29 -- http://www.nap.edu/catalog.php?record_id=12999) colleges and universities should be working with school administrators, counselors, and teachers to align the K-12 curriculum with the college curriculum.

- "States have developed high school assessments without much regard for what colleges need, and colleges use admissions and placement exams that are disconnected from the curriculum students study in high school." (*Closing the Expectations Gap*, 2006, p. 18 -- http://www.achieve.org/files/50-state-06-Final.pdf) States have moved in this direction, but more has to be done. (*Closing the Expectations Gap*, 2010 -- http://www.achieve.org/files/AchieveClosingtheExpectationsGap2010.pdf)

- "Colleges and universities can help by clarifying the requirements for success in higher education and working with elementary and secondary teachers and leaders to enable students to meet them." (*Accountability for Better Results*, 2005, p. 23 -- http://www.sheeo.org/account/accountability.pdf)

The challenge of getting students interested in STEM as a career choice is at what age/grade to begin. There have been some consideration to begin as early as grade 3

- Super's (1957) Developmental Self-Concept Theory:
  - From birth to mid-teens: developmental tasks are geared to form a general understanding of the world of work
    - Fantasy (4-10 years old) - needs shape career fantasies, little reality orientation.
    - Interest (11-12 years old) - likes/dislikes as basis for career choices
    - Capacity (13-14 years old) - more reality incorporated; can relate own skills to specific requirements of jobs.

Super's (1957) Exploration Stage

- Tentative (15-17 years old) - incorporates needs, interests, abilities which are tried out in fantasy, coursework, part time work, volunteering, or shadowing. The individual may identify the field and level of work at this time.
- Crystallization of Preference (18-21 years old) - General preference converted into specific choice based on reality from entering the job market, training after high school, or choosing a college major.
- Specifying a Vocational Preference (early 20's) - trial/little commitment; first job seen as life's work, but choice is provisional and person may go back to crystallizing and specifying substage if the experience is found wanting.

Discussing student retention and its implications also suggests placing an emphasis on P-20 transitions rather than the transition between elementary to middle school to high school

- "Critical to the success of the college- and career-ready agenda is the ability of states to collect, coordinate and use secondary and postsecondary data to improve the readiness of graduates to succeed in college and the workplace." (*Closing the Expectations Gap*, 2010, p. 17)

- The goal is to identify students who are college ready:

  "College readiness can be defined operationally as the level of preparation a student needs in order to enroll and succeed—without remediation—in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program. "Succeed" is defined as completing entry-level courses at a level of understanding and proficiency that makes it possible for the student to consider taking the next course in the sequence or the next level of course in the subject area." (Conley, 2007, p.5 -- http://www.gatesfoundation.org/learning/Documents/CollegeReadinessPaper.pdf)

STEM :Going Forward

- Developing Policies from current research
- Importance of recognizing Diversity of STEM
- Focus on K12 recruitment in STEM
- Focus on college –readiness of K12 students
- Focus on the different needs of engineering students from other STEM disciplines
- Recognize/research pathways in K-20 STEM education

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