Closing the Loop : Reengineering Engineering Education

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BACKGROUND

### College of Engineering Incoming and Graduating Student Numbers

Several Engineering courses have very high DFW rates.

Winners of 2017 academic year DFW competition

Course Code	Course Title	Enrollment	DFW Rate	Impact
EE210	Circuit Analysis I	236	44%	104
EE410	Signals and Systems	172	43%	74
EE204	Princ Electrical Engr	497	35%	175
ME200	Statics	500	29%	143
EE380	Electrical Energy Conver	146	29%	43
CIVE160	Stat Meth Built Environ	143	24%	34
EE310	Circuit Analysis II	224	23%	51

College of Engineering Historically suffered from low graduation rates.

| Metric	2025 SDSU Goal	Most Recent SDSU Rate	Most Recent Engineering Rate	2025 Engineering Goal
Freshman 6-year Graduation	85%	68%	63.76%	80.00%
Freshman 4-year Graduation	54%	36%	23.31%	35.00%
Transfer 2-year Graduation	51%	39%	12.90%	16.86%
Transfer 4-year Graduation	91%	81%	82.21%	92.00%
Gap – URM	0	9%	7.60%	0
Gap – PEL Eligible	0	6%	7.00%	0
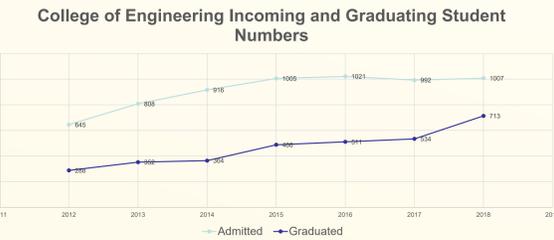
Engineering courses are highly dependent on knowledge units delivered in previous courses. Failing in a core course on the critical path could result in losing one semester or one year.

RESEARCH QUESTIONS

- How do we increase 4 year graduation rate to meet the 2025 goals?
- How do we reduce DFW rates in core courses on a critical path to graduation ?
  - What are the reasons for high DFW rates
- How do we integrate community colleges to our program ? How do we support them to improve quality of articulated courses ?
- How do we reduce achievement gap between student populations ?
- How do we use data to improve evidence based advising at the college ?
- How do we improve quality of instruction and asses learning?

METHODS

- Established baseline data for the College of Engineering with regard to incoming profiles, graduation rates, continuation rates, probation rates, and time to degree.
- Compile data on pre majors, super seniors
- A new course sequence analytics workbook to study "How success in a particular class effects other classes in a sequence ", course repeats and effects on time to degree.
- Revisit articulation agreements
- Decouple courses by removing unnecessary prerequisites
- Identify students who need academic support as early as possible and provide them with the tools to improve their chances of success.
- Identify students who do not have a high probability of success in Engineering and advise them properly
- Center for Student Success in Engineering

FINDINGS

Students are not adequately prepared in core science and math courses. We show physics 196 and EE210 relationship here as an example.

PHYS 196 Success Rate

EE210 Success Rate
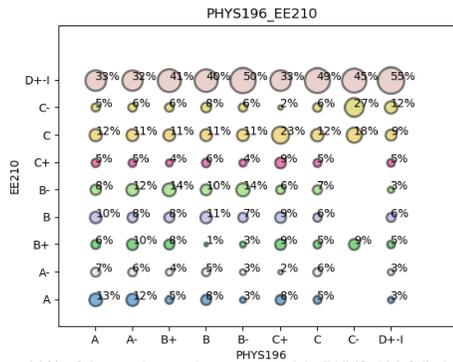
PHYS196_EE210

33% of the students who score an A in PHYS 196 fails in EE210. 41% of the students who scores a B+ fails in EE210.

Our Students are not registering and passing enough credits per semester.

Factors	Oveall	AE	CIVE	COMPE	CONSTE	EE	ENV	ME	
Entering GPA of Enrolled students as of Fall 2018 or 2017	3.68	3.72	3.69	3.65	3.74	3.57	3.54	3.74	Fall 2017 Cohort
Admitted	3071	472	481	435	53	311	253	1066	126 units
Enrolled	772	104	132	113	14	84	61	263	127 units
Average SAT	1217	1250	1189	1179	1193	1187	1217	1240	
Less than 4-year graduation rate	14.10%	16.70%	14.10%	13.08%		9.40%	6.90%	17.50%	2011 Cohort
Less Than 5-year graduation rate	55.90%	61.10%	57.50%	51.70%	55.60%	46.90%	55.20%	56.30%	2011 Cohort
Les than 6-year graduation rate	69.50%	72.20%	76.30%	69.00%	55.60%	59.40%	65.50%	68.00%	2011 Cohort

Factors	Overall	AE	CIVE	COMPE	CONSTE	EE	ENV	ME	
Total units required for graduation		134	132	126	127	127	133	134	2017 MyMap
Total units required for graduation		140	138	132	133	133	136	140	2018MyMap

- COMPE has the lowest number of units at 126 in 2017
- Average number of units passed by a COMPE student per semester 12.5 (FTF) and 11.2 (Transfer)
- Number of semesters (FTF) = 126/12.5 = 10
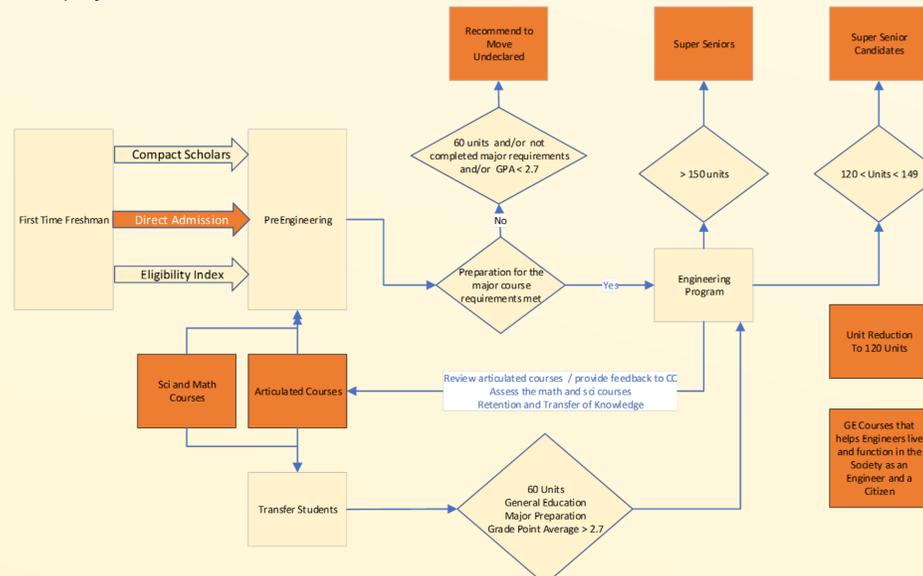- Number of semesters (Transfer) = 126/11.2 = 11.25

6 more units of GE is added to our program.

For ME student to graduate in 4 years with 2 semesters each it will require the student to pass 18 units per semester. Currently ME students register on the average for 14.6 units and pass only 13.5 units. With this success rate our students need 10.37 semesters.

CONCLUSIONS & FUTURE DIRECTIONS

We have decided to perform a comprehensive reform in our instructional process and address every gap in our program. Orange boxes in the following process diagram identifies the projects we started to serve our students better.

Close the Loop:

We initiated a tutoring program with 5 pilot courses that are holding our students back. Feedback is provided back to the professors teaching these courses every weeks. Professors provides tutors input on the subjects.

Vertical Feedback: We administered exams in EE210 to asses retention and transfer of knowledge acquired in PHYS 196, MATH 150/151 and preCalc. We provide feedback to MATH and PHYS professors on the knowledge gaps in the areas covered by these courses.

Meeting with Physics Professors exposed:
- Major cheating in exams is a concern
- Large class size without adequate support
- Poor scheduling practices
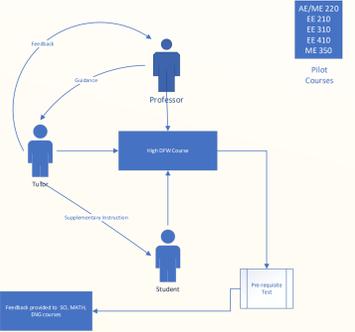
Learning Assessment and Course Readiness : Course readiness of a student was determined based on the overall performance of each student in an entry exam. Students are classified into two categories based on their knowledge of prerequisite subjects. Students not ready to take the course, denoted as "Readiness:0". The rest of the students who scored better than the minimum established for base knowledge level were categorized as ready for the course, denoted as "Readiness:1".

We observed poor performance in all exam by the students who were not ready for the course, as shown in the following Figures. The graph shows cumulative percentage of students scoring less than a particular grade. As can be seen students who are not course ready performed worse than students who are assessed as course ready in both midterm and final exams. Although the achievement gap in the final narrowed, it is still considerable. With students coming not ready to a courses the level of the course is also degraded.

Midterm1

Final_Histogram
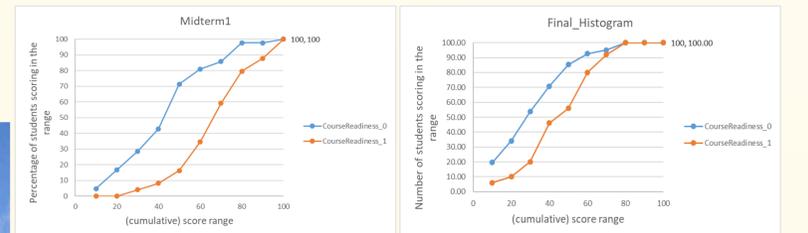
Current Projects in College of Engineering to Improve Student Success and Reduce Time to Graduate
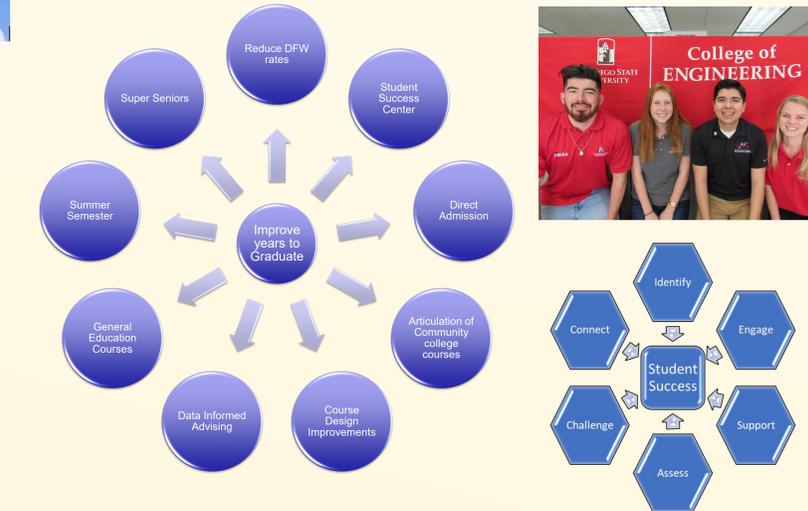
REFERENCES

- HIGH CHALLENGE (HIGH DFW) COURSE WORKING GROUP REPORT : CONTEXT, UPDATE, AND OPPORTUNITIES
- College of Engineering DFW action plan
- Data Champions Program Presentations and Lectures