Engineering Math Development at CBU Utilizing the WSU Model

(Current Year Two Results*)

Presented by Anthony Donaldson , PI
Founding Dean of Engineering
California Baptist University

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Overall Context for this work is somewhat unique

- CBU is a Private University (4000+ students in Riverside California – 32% minority, semester based)
- School of Engineering Started in 2006 (first classes Fall 2007)
  - 4 Degrees offered: CE, ECE, ME and Engineering (pre law, pre med, business and global applications)
  - Incoming class size (55, 67, 81, 90-100?(est)) Total over 220 this fall.
    - 35% ethnic minority,
    - 20% female
    - 22% international
    - 30+% of incoming students involved in athletics
  - Cohorts of students on presidential scholarship from Rwanda (11/12, 16/19, 14/16)
  - Full time Faculty (1,2,5,8,11,?) Currently 2 of 11 faculty are women
  - One year retention 82% (2nd highest school at the university), university average 70% (down from 84% due to economy)

Our NSF team has diverse and complimentary backgrounds

- Dr. Elizabeth Morris – PhD Mathematics Education (School of Education) – mentored Dr. Jung for EGR “100”
- Dr. Xuping Xu -Masters in Applied Math and PhD in EE from Notre Dame (School of Engineering) (taught 2 sections of EGR “101” including follow on to EGR “100”.
- Dr. Anthony Donaldson – PhD in EE, innovative curriculum work at TTU, SPU and CBU (School of Engineering)
- *Dr. Helen Jung* – PhD in CE, involved in K-12 outreach (*new faculty* (taught EGR “100” and developed new labs.
- *Dr. Ziliang Zhou* – PhD in ME, MBA, *new faculty* (taught one section of EGR “101”.
- Dr. Alex Chediak – PhD Material science Cal Berkeley – responsible for teaching and implementing a new inquiry based physics curriculum for our engineering program (joint appointment SOE and College of NMS)

Outstanding undergraduate curriculum is a focus and thus a fit for this model

- One of four articulated areas of focus for the school's activities
- One of ten distinctives desired for our programs
- Faithfulness in using vocational gifts for service is seen as a primary way we worship God and thus curriculum development is seen as directly tied to our school of engineering mission statement and its guiding verse ("For we are Christ's workmanship created in Christ Jesus for good works that God prepared in advance for us to do."Ephesians 2:10)

Course structure was changed to fully implement Wright State model

- 2007-2008 – algebra, precal or calculus entry points (WSU 100 1.0 introduced in fall, WSU 101 1.0 introduced for first two groups in spring 2008.)
- 2008-2009 – WSU 100 2.0 (labs added), WSU 101 2.0, Math anxiety assessment begun for 100.
- 2009-2010 – WSU 100 3.0 (EGR faculty and vertical integration "VI") WSU 101 3.0 (required course, VI and customized text started) Assessment using WSU questions was conducted.
- 2010-2011 – WSU 100 & 101 4.0 (Recitation sections and new labs-closing feedback loop. Adding additional VI feedback from Mathematics dept.), Optional labs for those placing out of Calc I and II. Math anxiety assessment for 101 started.

NSF WSU curriculum implementation

Example: BS Electrical and Computer Engineering
We also have BS CE, ME and general Engineering degrees

	Fall			Spring			Summer	
	Course #	CR	Description					
Year 1								
	EGR 182	4	Engineering Math II	MAT 245	4	Calc I		
	EGR 101	3	Engineering from a Ch	EGR 102	4	Intro to Engineering Design		
	EGR 121	3	Problem Solving and F	PHY 201	4	Mechanics/Waves		
	ENG 113	3	Composition I	EGR 122	3	Visualization Languages I		
	EGR 103	1	Engineering Service I	EGR 192	1	Freshman Seminar		
	GST 100	1	Focus					
		15			16			
Alternative	EGR 181	4	Intro to Egr Math I	EGR 182	4		MAT 245	Calc I
Year 2								
	PHY 203	4	E/M Optics	EGR 202	0	Worldview Reflection		
	EGR 231	4	Circuit Theory I	EGR 232	4	Circuit Theory II +Design		
	MAT 255	4	Calculus II	EGR 234	4	Digital Logic Design		
	ENG 123	3	Composition II		4	Science Elective*		
		3	GE#3		3	Upper Division Math**		
				EGR 221	3	Data Structures		
		18			18			

* BIO 146 or 153 or CHE 115
** preferred MAT 403, 413

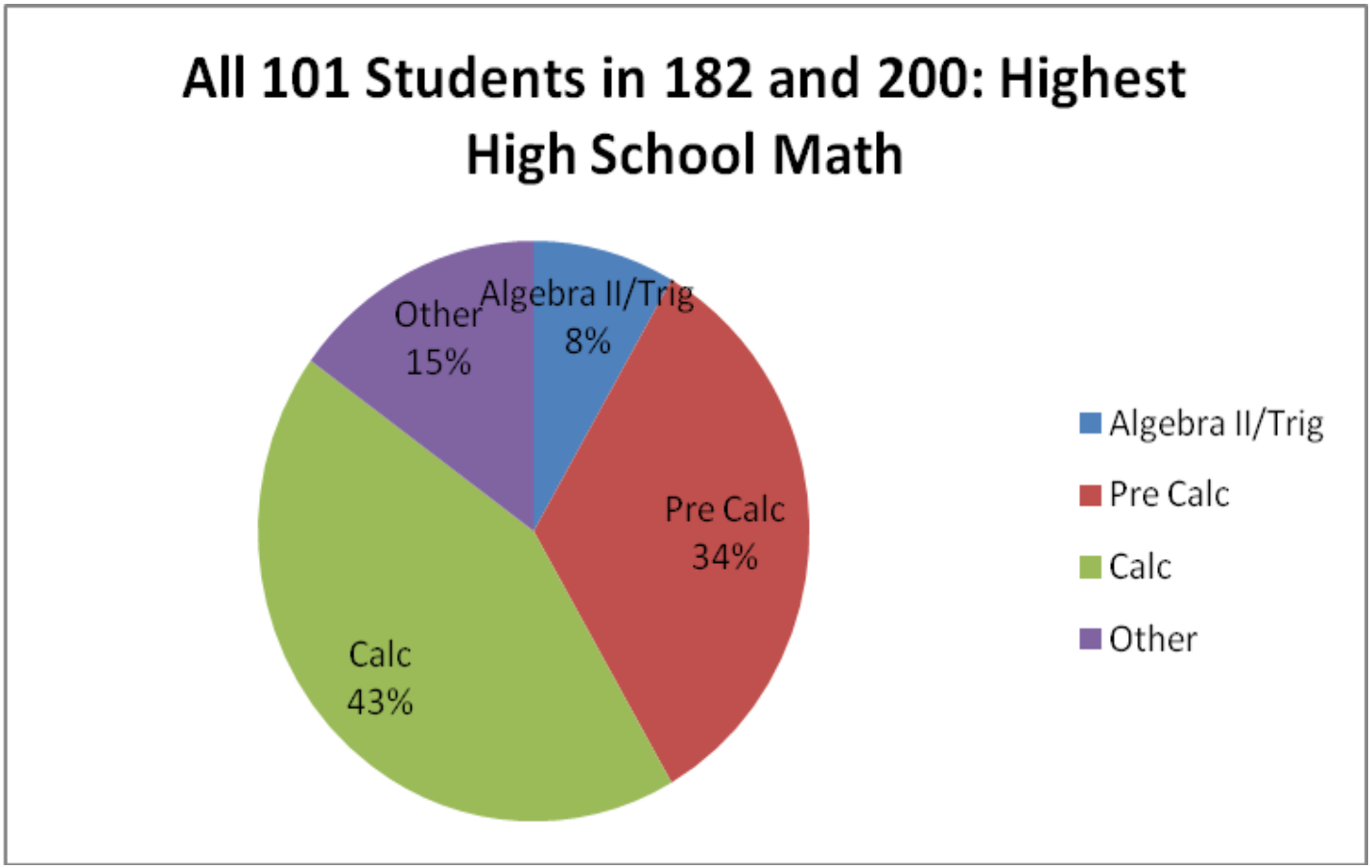
Note: EGR 181 is similar to WSU 100 but with a lab. EGR 182 is Wright State's 101
3 hours lecture, 1.5 hours lab 15 weeks.

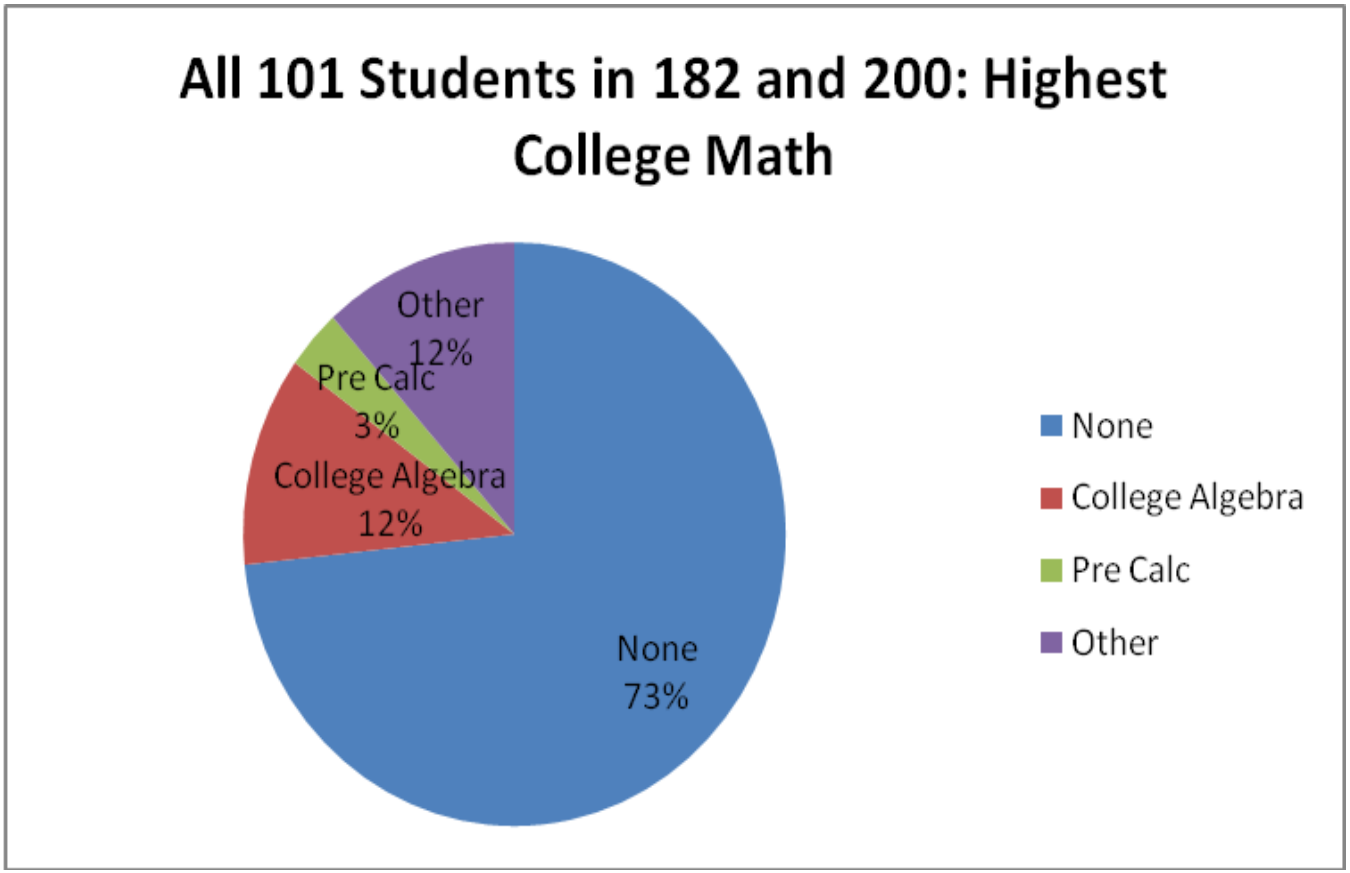
Vertical and horizontal integration “VI and HI” has been implemented

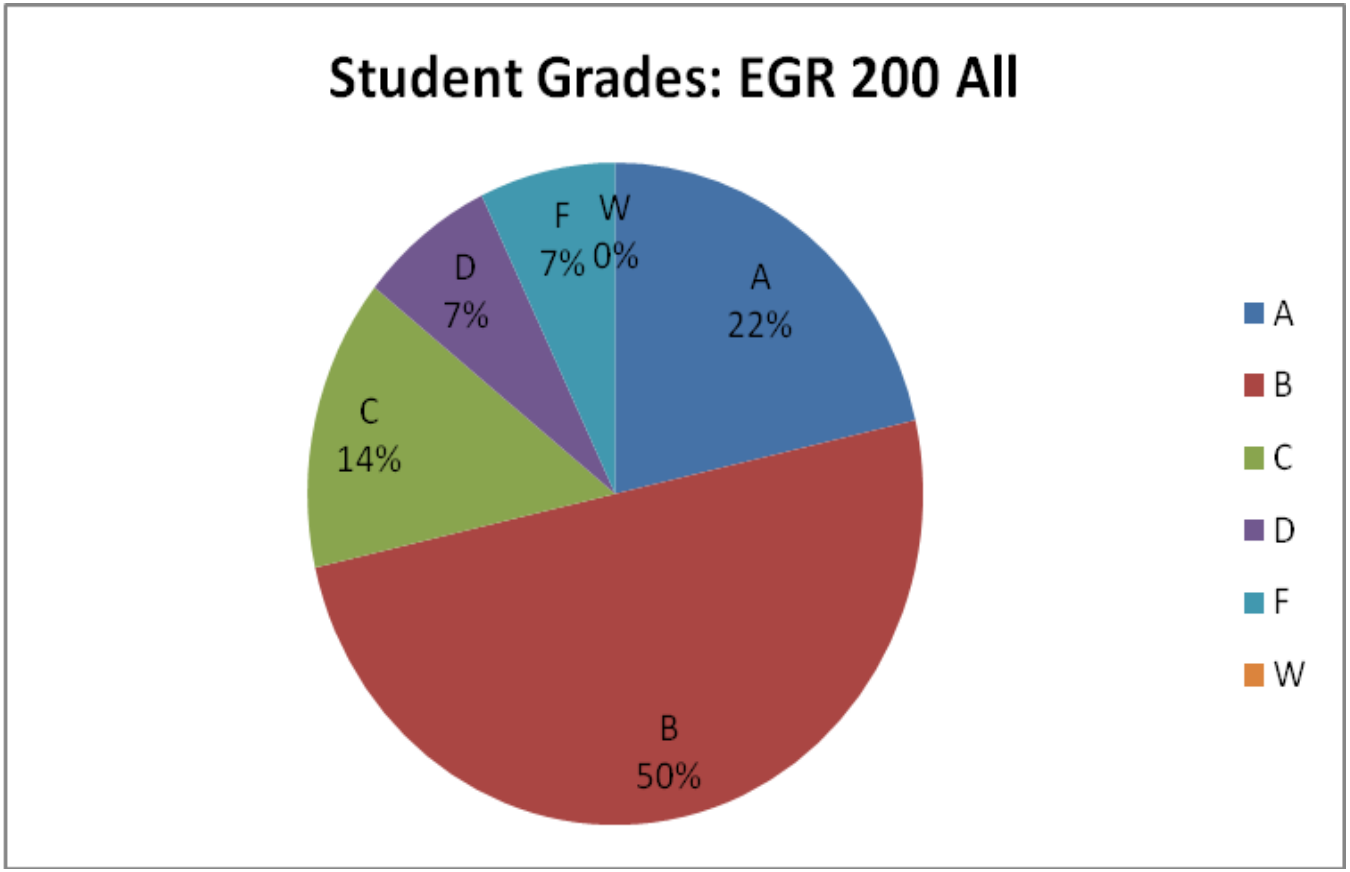
- 5 new labs developed for ‘100’ and ‘101’, were used in 2009 and 2010 more planned for this summer.
- Input from Physics (mechanics), circuits, statics, strength of materials and additionally Calculus I (taken after 101).
- Last fall 1 section of 100 and 2 sections of 101 will all be taught by engineering faculty with integrated (VI and HI)labs. (72 out of 81 students)

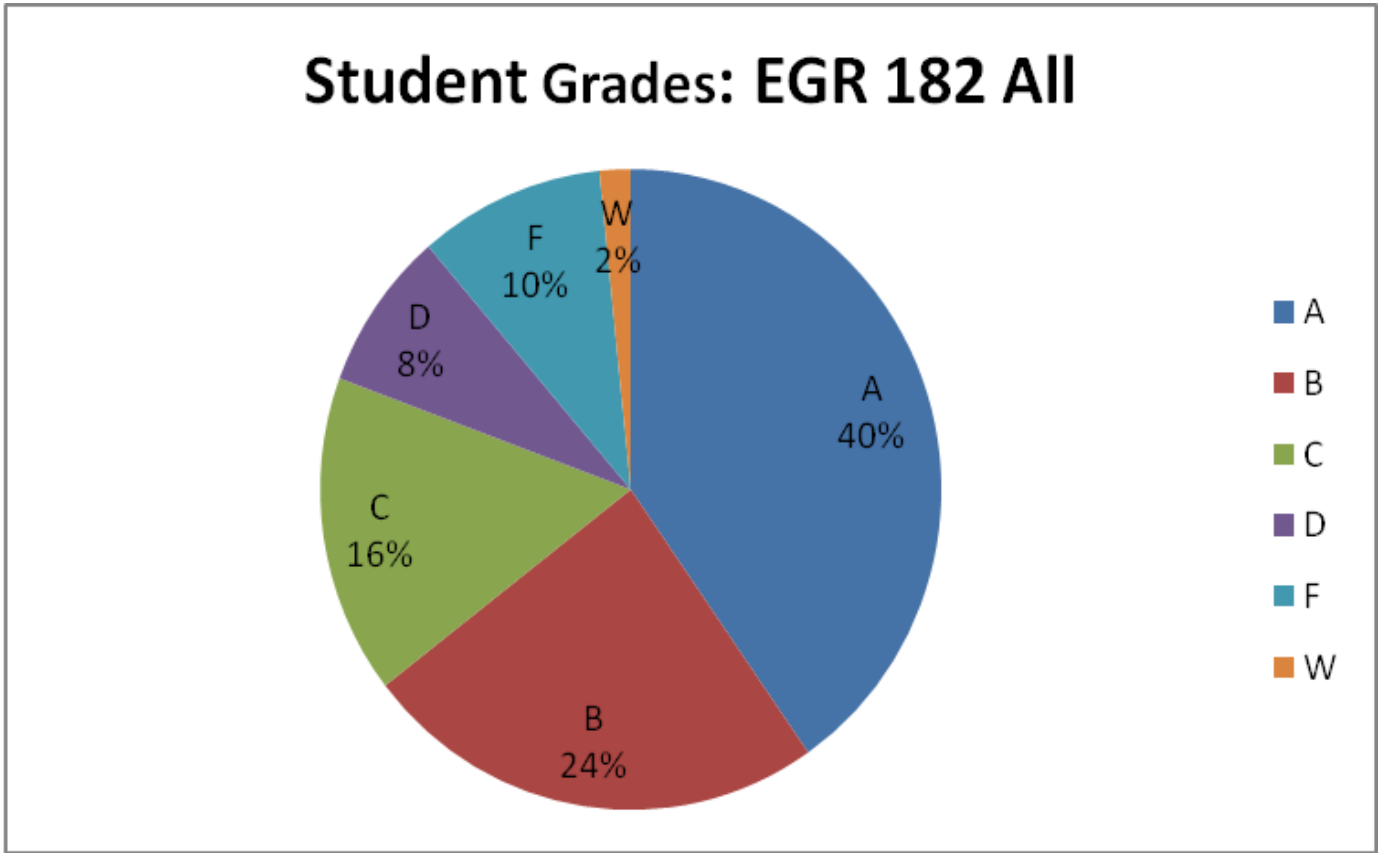
Results from assessment are very encouraging!

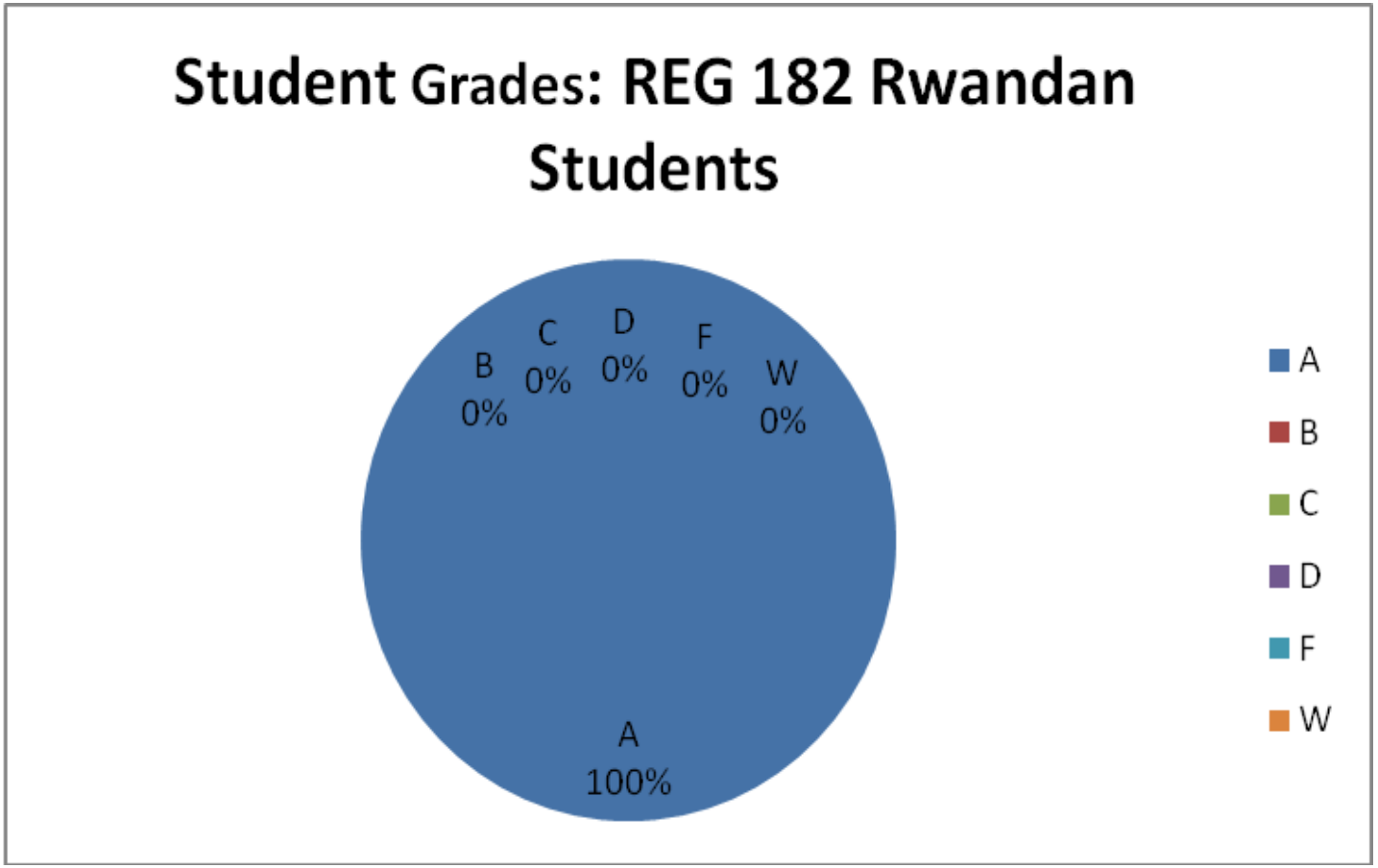
- 44% of ‘at risk’ students entering 100 in Fall of 2008 still in program after 1 year (WSU (MPL3) went from 26 to 48 %), **This past year CBU increased to 64%.**
- Student perception of benefit was highest for courses where we have begun to vertically integrate.
- Overall student perception of benefit was quite good. (see details on next slides)


All 101 Students in 182 and 200: Highest High School Math
Algebra II/Trig 8%
Pre Calc 34%
Calc 43%
Other 15%
Algebra II/Trig
Pre Calc
Calc
Other

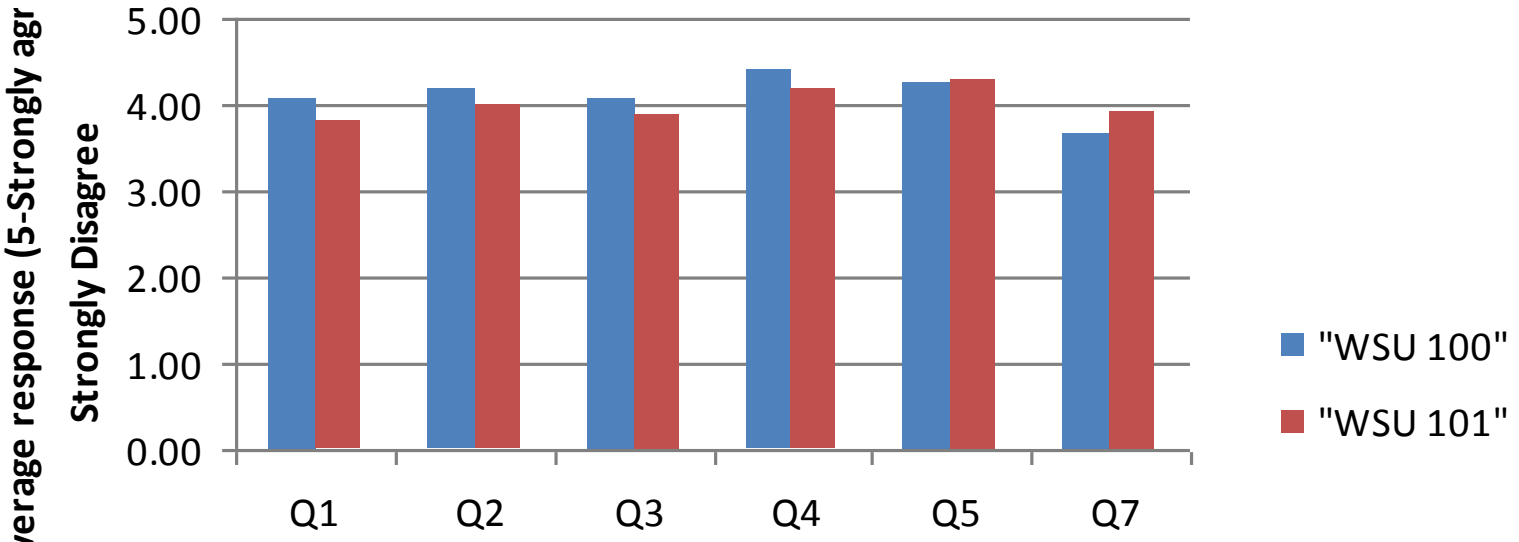

All 101 Students in 182 and 200: Highest College Math
Other 12%
Pre Calc 3%
College Algebra 12%
None 73%
None
College Algebra
Pre Calc
Other


Student Grades: EGR 200 All
A
22%
B
50%
C
14%
D
7%
F
7%
W
0%
A
B
C
D
F
W

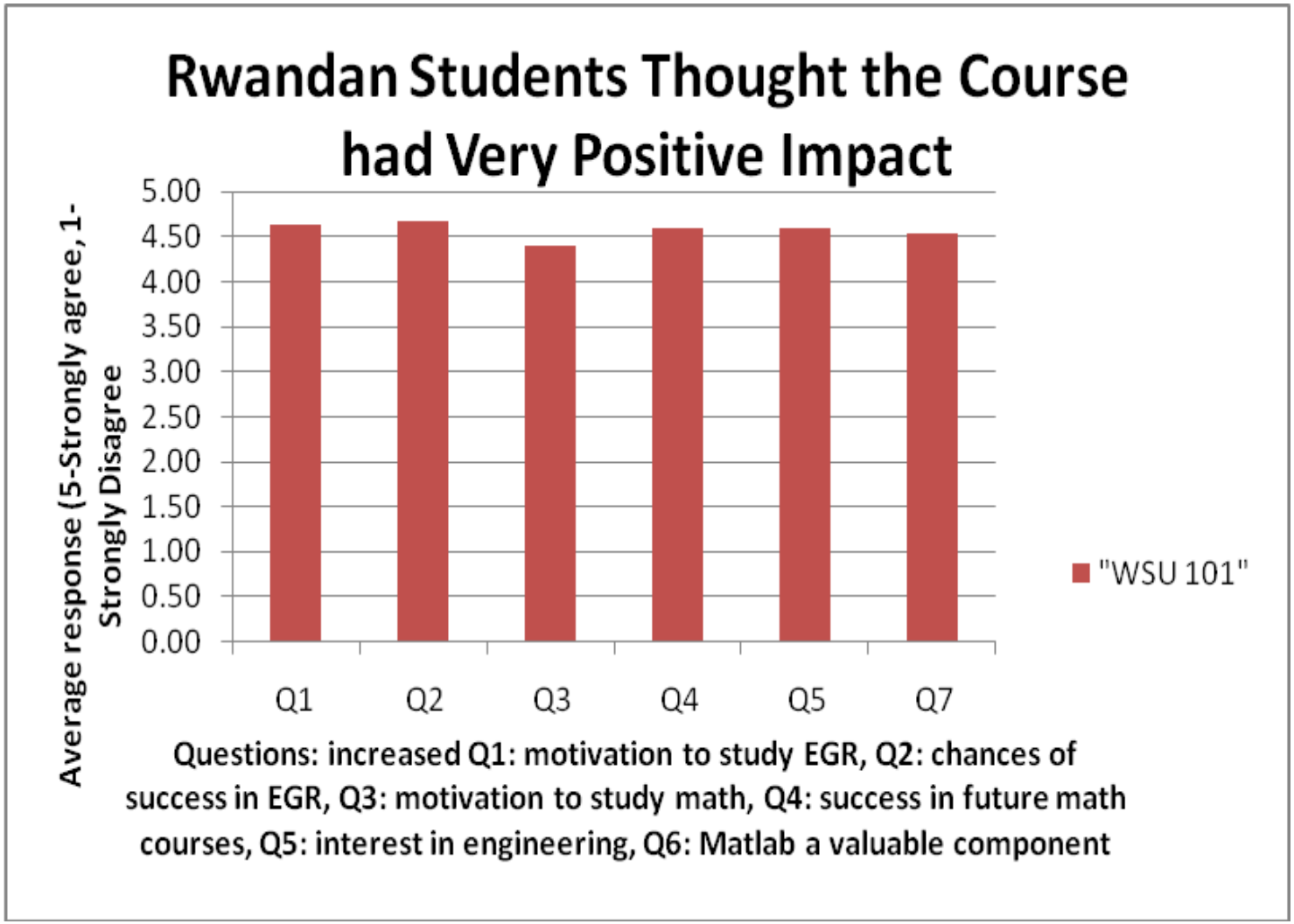

Student Grades: EGR 182 All
A
40%
B
24%
C
16%
D
8%
F
10%
W
2%
A
B
C
D
F
W


Student Grades: REG 182 Rwandan Students
B 0%
C 0%
D 0%
F 0%
W 0%
A 100%
A
B
C
D
F
W

Both Courses Had Positive Impact



Questions: increased Q1: motivation to study EGR, Q2: chances of success in EGR, Q3: motivation to study math, Q4: success in future math courses, Q5: interest in engineering, Q6: Matlab a valuable component


Rwandan Students Thought the Course had Very Positive Impact
Average response (5-Strongly agree, 1-Strongly Disagree
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Q1
Q2
Q3
Q4
Q5
Q7
"WSU 101"
Questions: increased Q1: motivation to study EGR, Q2: chances of success in EGR, Q3: motivation to study math, Q4: success in future math courses, Q5: interest in engineering, Q6: Matlab a valuable component

Note: Question Responses Were Effected by the GPA in course!
The higher the GPA, the higher the agreement!

Increase pre anxiety leads to increased performance!

Anxiety for EGR "100"

Anxiety Level	A Little	Fair Amount	Alot (1)
Final exam Avg	66	85	92
Gain	57	67	86

- The Mathematics Anxiety Rating Scale: Short Version was developed in 1972 by F.C. Richardson and R.M. Suinn.

Additional assessment is being implemented

- Math anxiety (pre and post for 101 as well)
- Correlation with a customized math placement exam
- Correlation for student performance in Calculus (w and w/o 101) is planned
- Correlation for student performance on National FCI for Physics is planned

Special Thanks

- Jeff Froyd (Head of Faculty development at Texas A&M)
- Nate Klingbeil at Wright State University
- The National Science Foundation

Overall student perception of 101 was very positive!

- **"EGR 101" increased motivation to study engineering** 4.29*
- **"EGR 101" contributed to success in subsequent EGR courses** 4.43
- **"EGR 101" increased motivation to study math** 3.86
- **"EGR 101" contributed to success in subsequent MATH courses** 4.43

*on a 5 point scale 5:strongly agree, 3:neutral, 1: strongly disagree

Algebra-Concepts in Physics

- Velocity as a function of time for a constant acceleration scenario (such as a glider sliding down a frictionless incline plane):

$$v(t) = at + v_0$$

- Again, the function is an example of:

$$y(x) = mx + b$$



Incline plane with glider. Photogate will measure the velocity.