Engineering Math Development at CBU Utilizing the WSU Model

(Current Year Three Results*)

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Overall Context for this work is somewhat unique

- CBU is a Private University (**5000+** 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 (bioengineering, pre law, pre med, business and global applications)
  - Incoming class size (55, 67, 81, 104, 120?(est)) Total over 280 this fall.
    - 35% ethnic minority,
    - 18% female
    - 22% international
    - 30+% of incoming students involved in athletics
  - Cohorts of students on presidential scholarship from Rwanda (11/12, 16/19, 14/16, 3/7)
  - Full time Faculty (1,2,5,8,11,14,?) Currently 2 of 14 faculty are women
  - One year retention 82% (2nd highest school at the university), university average 70% (down from 84% due to economy)
- First 24 graduates this last May!
  - All students required to take and pass the practice exam to graduate.
  - All 7 students who chose to take the actual FE exam passed.

Our growing NSF team has diverse and complimentary backgrounds

- *Dr. Ziliang Zhou* – PhD in ME, MBA, (has taught several sections of EGR "101". Work in progress paper on vertical integration with other faculty.
- *Dr. Rod Foist (new)– PhD in EE, (will be working with Dr. Donaldson to introduce new lab experiences into 101 this summer for Fall 2012.) Also has experience in teaching engineering in Asian context.*
- 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". Modified and rewrote text for use in "101".
- 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. 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)
- Dr. Elizabeth Morris – PhD Mathematics Education (School of Education) – mentored Dr. Jung for EGR "100"

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
- Directly tied with our understanding of what it means to be a faithful Christian engineering educator
  - 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

- 2011-2012 – Adding new labs for 100 and 101, Text and lab manuals for both courses, initial Asian context studies, better placement testing, Math anxiety pre and post testing for 100 and 101, additional vertical integration “VI”work. Optional labs for those placing out of Calc I and II. Test for credit exam for 100 and 101 lecture portions. Implementing team meetings for all EGR “100” and “101” teachers.
- 2010-2011 – WSU 100 & 101 4.0 (Recitation sections and new labs-closing feedback loop. Adding additional “VI” feedback from Math, Physics and Engineering faculty of sophomore classes), Math anxiety assessment for 101 started.
- 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.
- 2008-2009 – WSU 100 2.0 (labs added), WSU 101 2.0, Math anxiety assessment begun for 100.
- 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.)

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

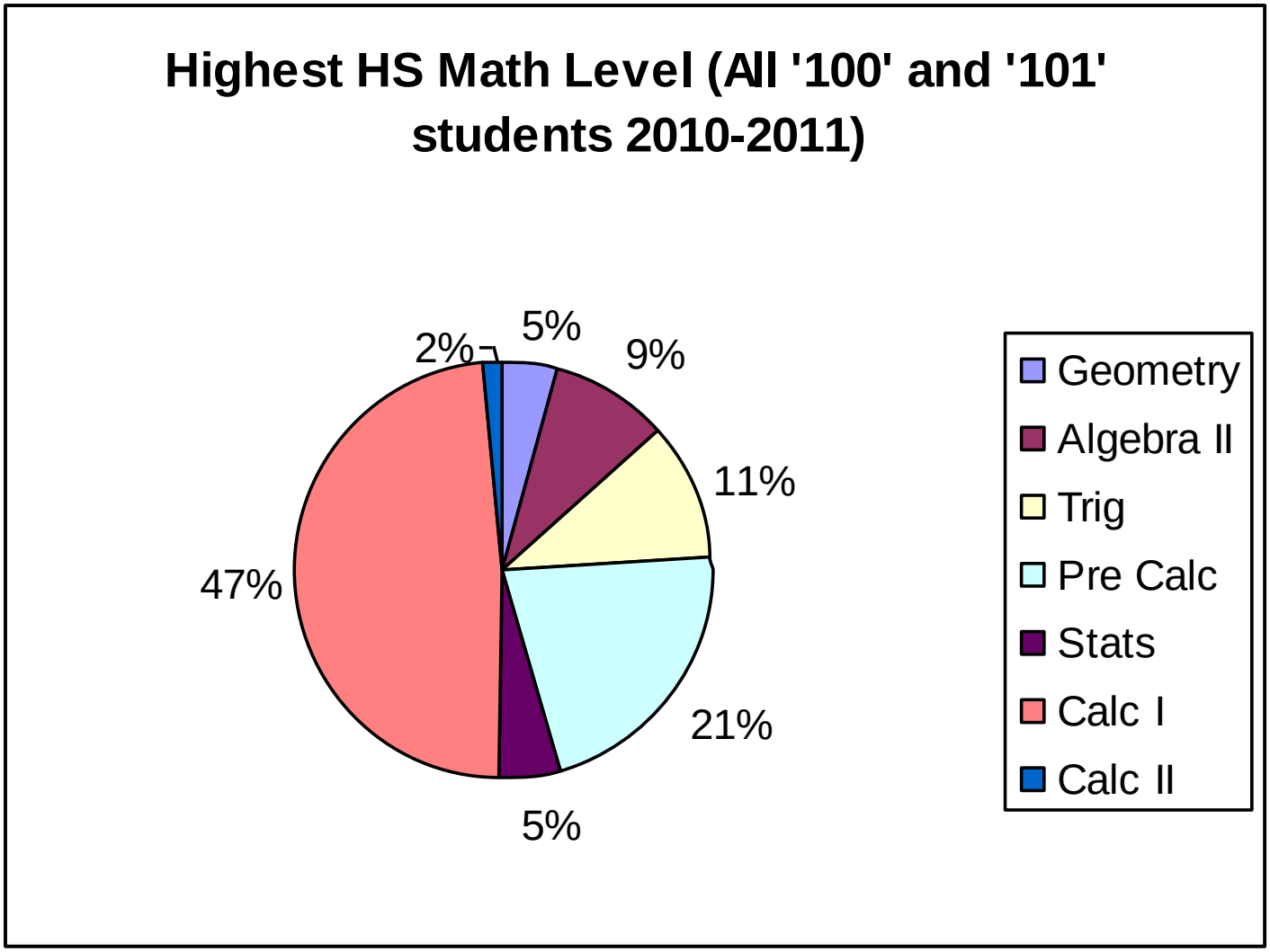
Note: EGR 181 is similar to WSU 100 but with a lab. EGR 182 is Wright State's 101
3 hours lecture, 1.5 hours lab 15 weeks.

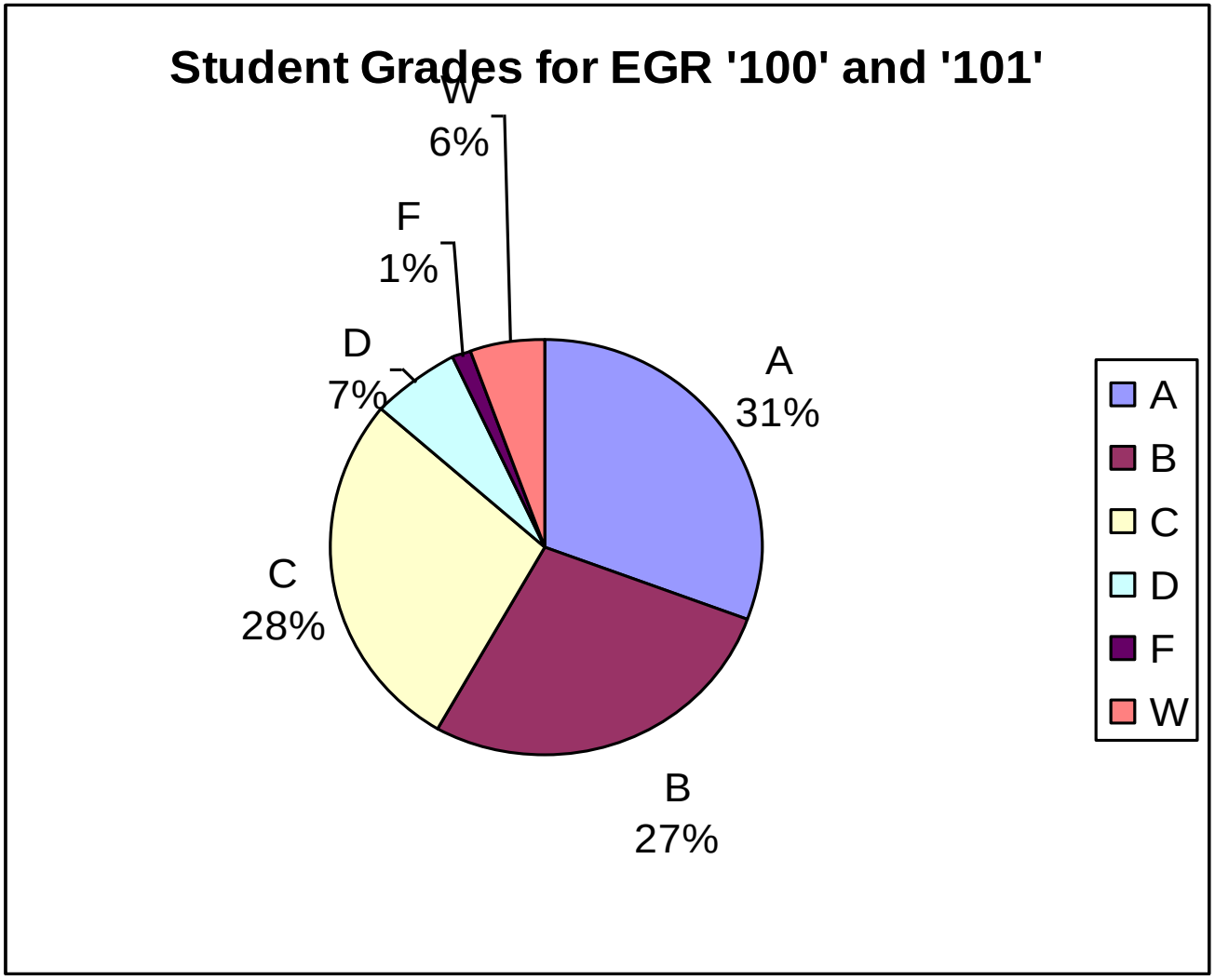
Vertical and horizontal integration “VI and HI” continues to be implemented

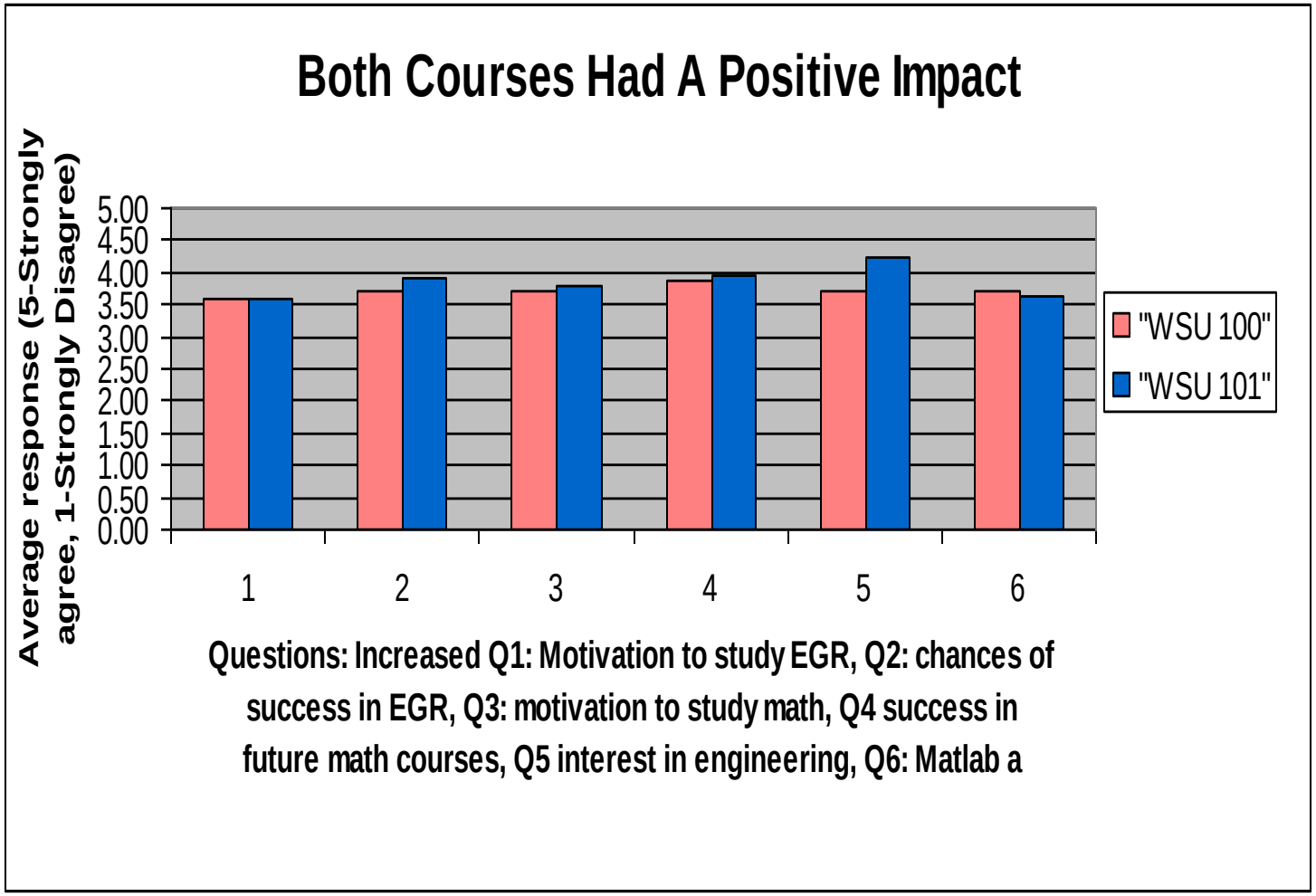
- New labs developed for ‘100’ and ‘101’, were used in 2010 and 2011 more planned for this summer.
- Input from Physics (mechanics), circuits, statics, strength of materials and additionally Calculus I (taken after 101). (Work in progress paper has been written and accepted for FIE).
- Each year 4 sections of 101 and 1 section of 100 are now taught.

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 %), **The last two years CBU above 50%**
- 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)


Highest HS Math Level (All '100' and '101' students 2010-2011)
5%
9%
11%
21%
5%
47%
2%
Geometry
Algebra II
Trig
Pre Calc
Stats
Calc I
Calc II


Student Grades for EGR '100' and '101'
W
6%
F
1%
D
7%
A
31%
C
28%
B
27%
A
B
C
D
F
W

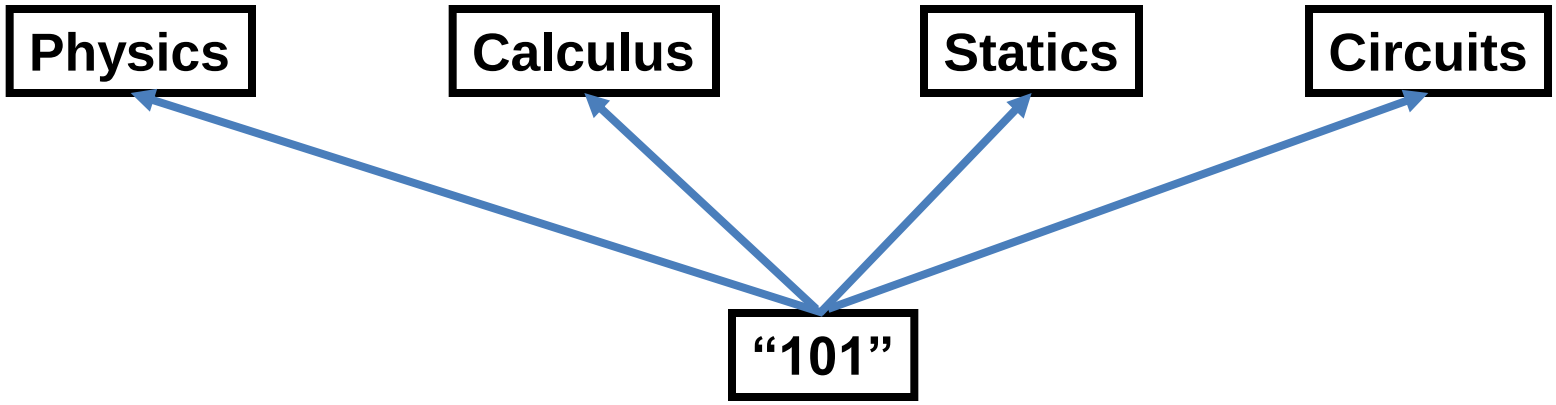

Both Courses Had A Positive Impact
Average response (5-Strongly agree, 1-Strongly Disagree)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1
2
3
4
5
6
"WSU 100"
"WSU 101"
Questions: Increased Q1: Motivation to study EGR, Q2: chances of success in EGR, Q3: motivation to study math, Q4 success in future math courses, Q5 interest in engineering, Q6: Matlab a

CBU Publication based on WSU Model

Work in Progress - Enhancing Communication among Courses Linked with Prerequisites

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Vertical Integration and Communication



prerequisite

One feedback example from Physics

$$a = \frac{dv}{dt} = vt$$

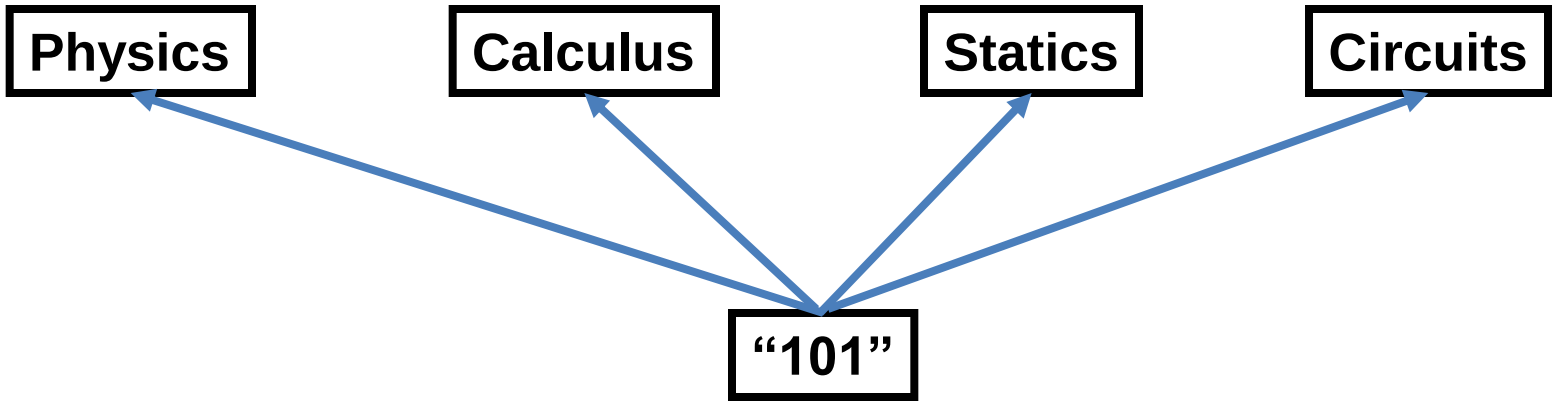
Actions taken within “101”

Used the specific example in HW & exam

$$a = \frac{dv}{dt} = f(v,t)$$

Proactively Seeking Feedback

$a = \frac{dv}{dt} = vt$ Word Problem No major issue $\frac{3+4i}{6e^{-\frac{\pi}{3}i}}$

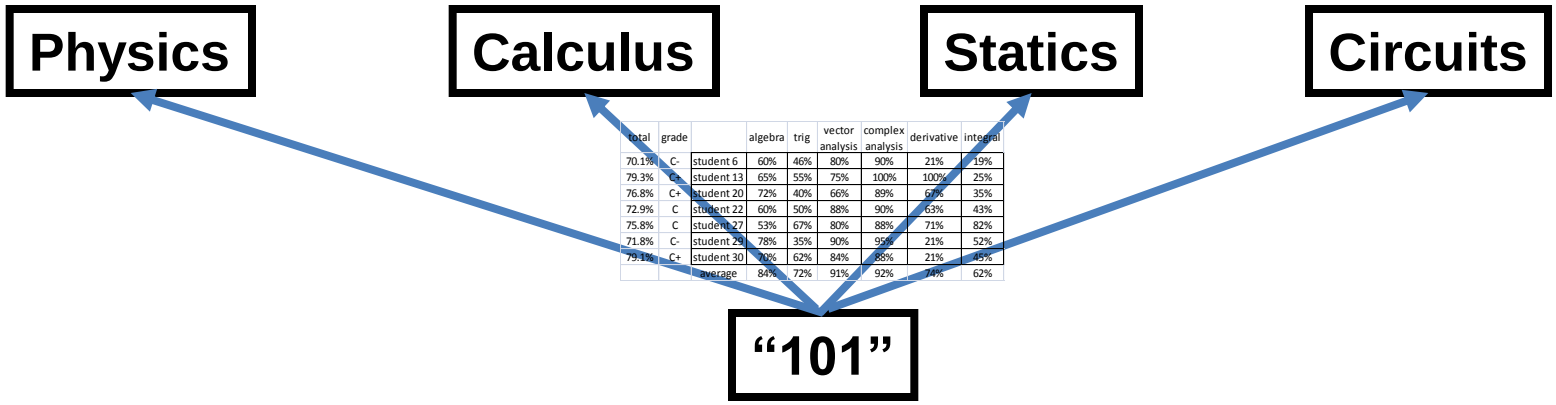


prerequisite

Record performance in subject areas

total	grade		algebra	trig	vector analysis	complex analysis	derivative	integral
70.1%	C-	student 6	60%	46%	80%	90%	21%	19%
79.3%	C+	student 13	65%	55%	75%	100%	100%	25%
76.8%	C+	student 20	72%	40%	66%	89%	67%	35%
72.9%	C	student 22	60%	50%	88%	90%	63%	43%
75.8%	C	student 27	53%	67%	80%	88%	71%	82%
71.8%	C-	student 29	78%	35%	90%	95%	21%	52%
79.1%	C+	student 30	70%	62%	84%	88%	21%	45%
		average	84%	72%	91%	92%	74%	62%

Report out the performance



total	grade		algebra	trig	vector analysis	complex analysis	derivative	integral
70.1%	C-	student 6	60%	46%	80%	90%	21%	19%
79.3%	C+	student 13	65%	55%	75%	100%	100%	25%
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prerequisite

Impact to instructors

Incoming student readiness

Offer a review session before starting a chapter, if necessary

total	grade		algebra	trig	vector analysis	complex analysis	derivative	integral
70.1%	C-	student 6	60%	46%	80%	90%	21%	19%
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Impact to Advisors

Course recommendation
Study between semesters

total	grade		algebra	trig	vector analysis	complex analysis	derivative	integral
70.1%	C-	student 6	60%	46%	80%	90%	21%	19%
79.3%	C+	student 13	65%	55%	75%	100%	100%	25%
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Impact to “101” instructors

Teaching effectiveness improvement
Time allocation in each subject

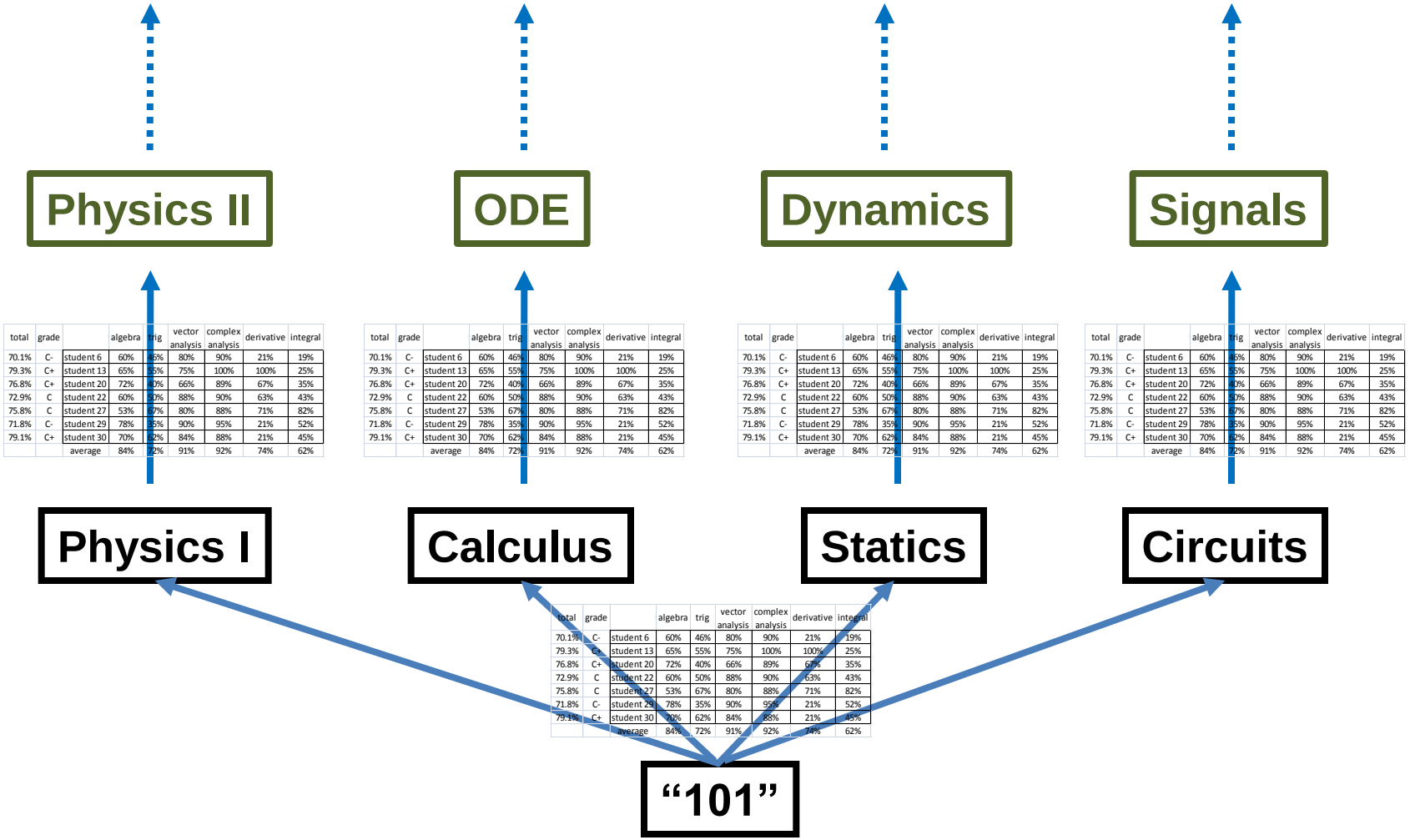
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Future Directions

Collect more data to verify impact

Expand to other courses linked with prerequisites



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Special Thanks

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