

*Making Value
for Society*

PRELIMINARY FINDINGS FROM ENGR1102 (WSU EGR101) IMPLEMENTATION

Keya Sadeghipour, PhD, Dean, College of Engineering, Temple University
Jamie Bracey, PhD, Director, STEM Education Temple University



VISION –

Create a culture of rigorous, engaging and high performing teaching, learning, research and innovation that permeates the College and drives a spirit of success for stakeholders

THEORY OF CHANGE –

Develop an aggressive evidence based assessment approach to identify, test, evaluate and scale cohort level interventions across the college.

GOAL –

Double retention and graduation rates within 6 years



The goal of ENGR 1102, based on Wright State's course EGR 101, was to improve likelihood of progression in engineering degree by remediating students who tested below Calculus I upon initial matriculation



ENGR 1102 INTRO MATHEMATICS FOR ENGINEERING APPLICATIONS

This course provides an overview of the salient math topics most heavily used in the core sophomore-level engineering courses. These include algebraic manipulation of engineering equations, trigonometry, vectors and complex numbers, sinusoids and harmonic signals, systems of equations and matrices, differentiation, integration and differential equations. All math topics are presented within the context of an engineering application, and reinforced through extensive examples of their use in the core engineering courses. Labs are based on the math principles taught in the course.



ENGR 1101 INTRODUCTION TO ENGINEERING

Provides an understanding of the study and practice associated with bioengineering, electrical, civil and mechanical engineering technology disciplines. Emphasizes the importance of good communications and teamwork skills in a successful engineering environment. Provides practice in problem solving and design. Discipline specific labs.



ENGR 1102 LECTURE TOPICS

- Applications of Algebra in Engineering – Linear and Quadratic Equations
- Trigonometry - One-Link Planar Robot Trigonometry - One and Two-Link Planar Robots
- 2-D Vectors in Engineering
- Complex Numbers in Engineering
- Sinusoids and Harmonic Signals in Engineering
- Systems of Equations and Matrices in Engineering
- Introduction to Derivatives in Engineering – Dynamics
- Applications of Derivatives - Mechanics of Materials and other examples
- Introduction to integrals in Engineering – Statics
- Introduction to integrals in Engineering – Dynamics
- Applications of Integrals - Electric Circuits and others
- Differential Equations
- Introduction to Differential Equations – Mechanical Systems

ENGR 1102 LABORATORY TOPICS

- Application of Algebra in Engineering: The One-Loop Circuit
- Trigonometric Relationships in One and Two-Link Robots
- Measurement and Analysis of Harmonic Signals
- Systems of Equations in Engineering: The Two-Loop Circuit
- Derivatives in Engineering: Velocity and Acc. In Free Fall
- Integrals in Engineering: Work and Stored Energy in a Spring
- Differential Equations in Engineering: 2nd Order RLC Circuit
- Differential Equations in Engineering: Spring-Mass Vibration
- MATLAB Supplemental Instruction



ESTABLISHING A BASELINE PROFILE

All incoming students for Fall 2014 were pre-and post-assessed using measures of tenacity and “grit” (Duckworth, et al 2009), interest profiles in engineering, and risk factor analysis based on math placement tests.

Development and Validation of the Short Grit Scale (Grit-S), Angela Lee Duckworth; Patrick D. Quinn, Department of Psychology, University of Pennsylvania, *Journal of Personality Assessment*, 91(2), 166–174, 2009



GRIT is defined as trait-level perseverance and passion for long-term goals and showed that grit predicted achievement in challenging domains over and beyond measures of talent.

- 95% of Temple’s oncoming engineering students considered themselves very “gritty” on average
- Mean - 3.68
- Standard Deviation - 0.47
- Scale of 1=no grit to 5=max grit



BASELINE MATH PROFILE FOR INCOMING ENGINEERING STUDENTS

- 41.7% (N = 160) of students placed into Calculus I
- 13.8% (N = 53) of students placed into Pre-Calculus
- 29.2% (N = 112) of students placed into College Algebra
- 1.8% (N = 7) of students placed into Elementary/Intermediate Algebra



MATH PERFORMANCE DATA FOR THE FALL 2014 COHORT

	ENGR 1101 N=240	Pass	Fail	With drew		ENGR 1102 N=49	Pass	Fail	With drew
Pre-Calculus	18%	45%	52%	3%		37%	56%	44%	
College Algebra	25%	50%	50%			31%	67%	33%	

- Students who tested into lower level math courses passed their math courses at a higher rate than their peers who did not take ENGR 1102
- ENGR 1102 students who tested into pre-calculus and college algebra, and took ENGR 1102 simultaneously, were strongest beneficiaries of ENGR 1102



ADDITIONAL OBSERVATIONS

- 72% of incoming students believed they were sufficiently prepared to study engineering in high school, but only 36% had ever had a course or participated in an afterschool club related to engineering
- Two thirds (67%) of incoming were motivated by a ***desire to design, build and improve things*** compared to 23% who were interested in future earnings, and those who indicated a ***desire to design, build and improve things*** demonstrated higher levels of grit than their peers
- 99% of incoming students expected strong support from faculty and other engineering students to succeed in acquiring a degree



KEY FINDINGS AND NEXT STEPS

- ENGR 1102 improved the math performance of a statistically significant number of Temple Engineering students who tested below Calculus I, increasing their confidence and likelihood of progression in the degree
- The College has secured Provost-level support for the following proposals:
 - ENGR 1102 be approved as a substitute for Pre-Calculus by Math and Physics departments;
 - Include engineering-related problems in current Calculus I-III sequences taught by Temple's math department; and
 - Create dedicated sections for ENGR students to take math courses together



KEY FINDINGS & NEXT STEPS (CONTINUED)

- Temple University College of Engineering now provides different initial pathways to obtaining Engineering degree, based on initial student profiles, to better manage expectations for incoming students
- We believe we reduced initial attrition by 5-10%, not accounting for financial aid challenges
- Faculty feedback and support has increased exponentially to support retention, graduation, and post-graduation placement

