Implementation of Engineering Mathematics at Western Michigan University

Project Team

- Dr. Abdel-Qader, Electrical and Computer Engineering
- Dr. James Kamman, Mechanical and Aeronautical Engineering
- *Dr. Edmund Tsang, Associate Dean*

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Presentation Overview

- ENGR 1990 Curriculum Development
- ENGR 1990 Evaluation
- Path Forward
- Conclusion

The Beginning ENGR 1990 at WMU

- A presentation (Fall 2007) by Dr. Nathan W. Klingbeil to WMU's CEAS Faculty on Wright State University's Engineering Mathematics Education Model

ENGR 1990- Curriculum Process

- Target Pre-Calculus Students
- MAE and ECE Departments Approvals
  - MAE students can use ENGR 1990 for science elective
  - EE students can use ENGR 1990 for ME elective
- Mathematics Department provided letter of support
- College Curriculum Committee Approval in Spring 2009
- HSIRB approval in Summer 2009

ENGR 1990 - Course Description

- **ENGR 1990 Engineering Mathematics (3 credit hrs: 2 hrs lecture, 3 hrs lab)**

  Application of mathematics to introductory engineering problems. Topics include mechanical and electrical engineering applications using algebra and trigonometry, vectors, sinusoids and harmonic functions, systems of equations and matrices, simple derivatives and integrals, and simple linear differential equations.

  Prerequisite: MATH 1110 (Algebra II) or ACT MATH Score (24-26) or equivalent or Permission of Instructor.

ENGR1990 - Curriculum Development

- Spring 2009 and Summer 2009
  - Review of Wright State University materials
  - Develop additional materials
- Fall 2009 and Spring 2010
  - Pilot implementation
  - Materials revised based on pilot implementation
- Summer 2010
  - Internal review by one ME and one EE professors
  - External review by one EE professor
  - Reviews are all positive
- Course materials can be found on

http://www.mae.wmich.edu/faculty/kamman/engr_1990.htm

ENGR 1990 and WMU-STEP

- ENGR 1990 serves as anchor class for a learning community for MAE/EE Pre-Calculus students
- Students are enrolled in the same section of Pre-Calculus, General Chemistry I/Lab
- MAE students are enrolled in the same section of engineering graphics
- EE students are enrolled in the same section of digital logic

ENGR 1990 – Implementation

- Student enrollment in ENGR 1990

Semester	# of Student
Fall 2009	16
Spring 2010	7*
Fall 2010	25
Spring 2011	6*

* MAE students in Algebra II learning community in Fall Semester were advised to take ENGR 1990 in Spring Semester

ENGR 1990 Evaluation: Student Performance

Performance comparison - MATH 1180 and CHEM 1100/1110

- ENGR 1990 students have a statistically significant ($\alpha<0.05$) higher successful completion rate in MATH 1180 (grades =/> C)

Semester	ENGR 1990	Comparison
Fall 2009	66.7%	28.0%
Fall 2010	80.0%	42.8

- No statistically significant difference in CHEM 1100/1110
  - Successful completion rate in CHEM 1100/1110
    - 73.3% /66.7% (Fall 2009) for ENGR 1990 Cohort
    - 81.8%/90.9% (Fall 2010) for ENGR 1990 Cohort
- No statistically significant different in 2nd year retention to CEAS
  - 73.3% (ENGR 1990) vs. 67.9% (CEAS-Pre-Calculus) – Fall 09 Cohort

ENGR 1990 Evaluation: Student Survey

Ten-item pre- and post-survey

- Three items on
  - motivation to study engineering and use of math to solve engineering problems
  - Confidence about chances of success
- Seven items on confidence about ability to solve engineering problems using
  - Algebra, trigonometry, vectors, simple differentiation, simple integration, harmonic functions, and computer simulation

ENGR 1990 Evaluation: Survey Results

Statistically significant difference ($\alpha<0.05$) in pre-/post-survey

Fall 2009

- Increase in confidence about ability to use trigonometry, vectors, and simple differentiation to solve engineering problems

Fall 2010

- Increase in confidence about ability to use trigonometry to solve engineering problems
- Decrease in confidence about chances of success in Engineering

ENGR 1990 Evaluation: Student Comments

Majority very positive

- Fall 2009

- *"Each lesson was presented in a perspective that I was unfamiliar with and caused me to think about math in a new way…Create similar classes for more advanced students to strengthen their knowledge and comfortableness transitioning between math thoughts at main campus and math in engineering."*

- Fall 2010

- *"This course was extremely helpful…helped bridge the gap between math and science, to show how all of it will be used in engineering. The course helped me understand the core concepts for the basis of engineering. I hope the college of engineering is able to keep this course, it helps greatly and I would hate to see it die out."*

Path Forward

- Present evaluation results to CEAS Executive Committee of dean, associate deans, and department chairs – Summer 2011
- MAE department plans to recommend first-year students initially placed in Algebra 2 in fall semester to take ENGR 1990 in spring semester beginning 2012
- Budget constraints could restrict how often ENGR 1990 will be taught

Conclusion

- ENGR 1990 successfully developed and implemented at WMU
- Evaluation
  - Students in ENGR 1990 have a statistically significant higher successful completion rate in Pre-Calculus than comparison
  - Students become more confidence in ability to solve engineering problems using trigonometry
  - Student comments show they are satisfied with ENGR 1990 and course provides new perspective about math in engineering
- State/university budget situations present greatest hurdle

QUESTIONS?

