

AC 2007-2218: ADDRESSING STUDENT RETENTION IN ENGINEERING AND ENGINEERING TECHNOLOGY THROUGH THE USE OF A MULTIDISCIPLINARY FRESHMAN COURSE

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Addressing Student Retention in Engineering and Engineering Technology Through the Use of a Multidisciplinary Freshman Course

Abstract

The Engineering Fundamentals Division of the Batten College of Engineering and Technology (BCET) at Old Dominion University administers a freshman engineering course sequence, along with four engineering departments (Mechanical Engineering, Civil and Environmental Engineering, Aerospace Engineering, and Electrical and Computer Engineering) and the Department of Engineering Technology (which offers degrees in Mechanical Engineering Technology, Civil Engineering Technology and Electrical Engineering Technology). The two course sequence, Exploring Engineering and Technology I and II, involve the five departments in teaching at least one five week module in each of the two courses. Each department generally involves the students in a basic design project related to its discipline.

The freshman course sequence has provided an excellent opportunity for the BCET to interact with first year engineering students to address the issues related to student retention and allows the division to provide student guidance in determining the appropriate major that best satisfies their individual needs in choosing a career in Engineering and Engineering Technology. The short time available to each program presents unique challenges in giving the students a meaningful experience in each discipline represented in the program. This paper presents these challenges and how the program has addressed them, as well as the continual process improvement being undertaken by the faculty to keep the program engaging for the students. Additionally this paper highlights the retention rate changes in the college as a result of this program.

Introduction

Retention of engineering students has become a major undertaking for most institutions with engineering programs. Much of this retention effort is taking place at the freshmen level, where dropout rates have been the highest. Institutions are developing innovative ways to maintain interest of freshmen students in their disciplines and the desire to continue.

The Engineering Fundamentals Division at the Old Dominion University has been in existence for several years. The Division prepares intended Engineering majors for admission to a degree-granting Department in the College of Engineering. Central to the Division is a two-course sequence for first-year students with the objective of providing an authentic engineering design experience and an introduction to engineering. The concept of “engineering up-front” with hands-on, team-oriented introduction to engineering is the philosophy behind the course.¹ The enhancement of the Division with these courses to enhance interest in engineering leading to higher matriculation rates, increased retention, and ultimately a higher graduation rate.

Background

Still faced with an under-prepared incoming student population, the Division felt the need to infuse some events and techniques into the introductory freshman-engineering course to increase student retention and success in progress toward engineering degree programs. There is belief that a holistic approach in developing the first-year engineering student to not only function as team-oriented critical thinker but also how to be successful students.² Therefore, introductory courses have evolved into a combination of actions, plans, and intrusive interventions into the college freshmen's life. Conversion into an active learning format with hands-on experience was necessary decrease student attrition in these disciplines.

Student Advising

A key component of the Engineering Fundamentals division is advising. The first-year engineering student has a safety net inclusive of a professional advising team, faculty mentors, learning cohorts, and supplemental instruction that promotes nurturing. The professional advising team consists of an academic advisor, a freshman success advisor, and a career advisor. The freshman success advisor works with students categorized as such that special attention is needed to ensure their success, based upon high school grades, SAT scores, math placement scores, and scores on the Transition to College Inventory (TCI). The career advisor assists students with bridging their academic development with practical experience. In addition to the professional advising team, students have access to four faculty mentors from each department of engineering who work collaboratively with the advising team to facilitate students' understanding of the meaning and purpose of higher education and fosters their intellectual and personal development toward academic success and lifelong learning.³

Engineering Fundamentals Division Curriculum

Engineering Fundamentals Division
Kaufman Hall, Room 132C
2006-2008 Catalog

Name: _____

UIN: _____

You will be advised by Freshman Faculty Mentors in the Engineering Fundamentals Division, 683- 5877

| ENGINEERING FIRST SEMESTER | | | | Term | Grade | Pre/Co-Requisites |
|----------------------------|----------------------|---|-------|-------|-----------------------|-------------------|
| ENGN 110 | Engineering & Tech I | 2 | _____ | _____ | C-MATH 162 | |
| CHEM115N | Chemistry I | 4 | _____ | _____ | P-MATH 102M | |
| MATH 211 | Calculus I | 4 | _____ | _____ | P-MATH 162 | |
| ENGL 110C | English Comp I | 3 | _____ | _____ | P-Pass Placement test | |
| **GEN 101 | NewPAGE | 3 | _____ | _____ | P- Freshman | |

** This course may be used as a substitution for one three- or four-hour course from the six General Education Perspectives areas.

| ENGINEERING SECOND SEMESTER | | | | Term | Grade | Pre/Co-Requisites |
|-----------------------------|----------------------|---|-------|-------|--------------|-------------------|
| ENGN 111 | Engineering & Tech 2 | 2 | _____ | _____ | C-MATH 162 | |
| CHEM 117 | Chemistry II | 3 | _____ | _____ | P-CHEM 115N | |
| MATH 212 | Calculus II | 4 | _____ | _____ | P-MATH 211 | |
| CS 150 | Intro to Programming | 4 | _____ | _____ | P-MATH 102M | |
| PHYS 231N | University Physics I | 4 | _____ | _____ | P/C-MATH 211 | |

| TECHNOLOGY FIRST SEMESTER | | | | Term | Grade | Pre/Co-Requisites |
|---------------------------|----------------------|---|-------|-------|-------------|-------------------|
| ENGN 110 | Engineering & Tech I | 2 | _____ | _____ | C-MATH 162 | |
| MATH 162 | Pre-Calculus I | 3 | _____ | _____ | P-MATH 102M | |
| **GEN 101 | NewPAGE | 3 | _____ | _____ | P-Freshman | |

** This course may be used as a substitution for one three- or four-hour course from the six General Education Perspectives areas.

Additional courses for MET or CET

| | | | | | |
|----------|--------------|---|-------|-------|-------------|
| MET 100 | Eng Graphics | 3 | _____ | _____ | |
| CHEM115N | Chemistry I | 4 | _____ | _____ | P-MATH 102M |

Additional courses for EET or CpET

| | | | | | |
|---------|------------------------|---|-------|-------|-----------|
| EET 120 | Logic Circuits & Micro | 3 | _____ | _____ | C-EET 125 |
| EET 125 | Logic Circuits Lab | 2 | _____ | _____ | C-EET 120 |

| TECHNOLOGY SECOND SEMESTER | | | | Term | Grade | Pre/Co-Requisites |
|----------------------------|----------------------|---|-------|-------|-----------------------|-------------------|
| ENGN 111 | Engineering & Tech 2 | 2 | _____ | _____ | C-MATH 162 | |
| MATH 163 | Pre-Calculus II | 3 | _____ | _____ | P-MATH 162M | |
| PHYS 111N | General Physics | 4 | _____ | _____ | P-MATH 102M | |
| ENGL 110C | English Composition | 3 | _____ | _____ | P-Pass Placement test | |

Additional courses for MET or CET

| | | | | | |
|---------|---------------------|---|-------|-------|-----------|
| MET 230 | Comp-Aided Drafting | 3 | _____ | _____ | P-MET 100 |
|---------|---------------------|---|-------|-------|-----------|

Additional courses for EET or CpET

| | | | | | |
|---------|-----------------------|---|-------|-------|------------|
| EET 110 | Electrical Circuits I | 3 | _____ | _____ | P-MATH 162 |
|---------|-----------------------|---|-------|-------|------------|

TEST SCORES:

Math Placement Test: _____ Writing Placement Test: _____ Foreign Language: _____

Date of Preview Intake: _____ Signature of Advisor: _____

Date of Spring Pre-registration Intake: _____ Signature of Advisor: _____

Date of Fall Pre-registration Intake: _____ Signature of Advisor: _____

Exhibit 1, First Year Curricula Engineering Majors and First Year Curricula Engineering Technology Majors

The collaborative educational process of the Engineering Fundamentals Division insures a partnership between students and academic advisors in meeting the essential learning outcomes, ensuring academic success, and outlining the steps for achievement of the students academic and career goals. Student attrition is the biggest problem with any engineering program.

Faculty Mentors

The EFD Faculty Mentors are on hand to advise students on each of the undergraduate engineering programs

Electrical and Computer
Engineering



Dr. Amin Dharamsi

Civil and Environmental
Engineering



Dr. William Drewry

Mechanical Engineering



Dr. Sushil Chaturvedi

Engineering Technology



Professor Rick Jones

Exhibit 2, Faculty Advisors

Root Cause Analysis

The Batten College of Engineering and Technology has identified some root causes of student attrition⁴ and has developed the Engineering Fundamentals Division to incorporate systematic strategies for student persistence. Some root causes include:

- 1) disinterest in/boredom with the content of courses or their method of delivery
- 2) perceived irrelevance of the college experience
- 3) social factors and emotional issues
- 4) perception that the cost of college outweighs its benefits

High attrition stems from inadequately prepared students to accommodate the academic demands of college and meet minimal academic standards, i.e., attrition due to academic failure or dismissal. The Engineering Fundamentals Division allows collaboration between course instructors and academic support services to promote effective identification and academic referral of students needing academic skill building. Another strategy is promoting early academic skill-development by infusing not only team-oriented projects in the Introduction to Engineering course but stressing academic success strategies into the first-year course.

Development of Retention Strategies

To address the root causes of attrition the Batten College of Engineering and Technology identified. The Engineering Fundamentals Division developed and incorporated systematic strategies⁵ to aid the college in retaining its students.

1. *Attrition may also be triggered by lack of student interest in, or enthusiasm for, the type of academic learning experience that characterizes the traditional engineering curriculum.*

Retention Strategies:

- Faculty Development—promoting the use of “engaging” pedagogy
 - Curriculum Development—promoting the design of “engaging” projects or modules.
 - Collaboration between academic departments and career development services
2. *Attrition caused by an absence of personal and meaningful social contact with other members of the college community, resulting in feelings of separation or marginalization.*

Retention Strategy: Promoting students’ “social integration”

- Promoting student-student (peer) interaction - team-oriented projects
 - Promoting student-faculty interaction - Intro course and faculty mentors
 - Promoting student-staff interaction – advising team
3. *Attrition caused by the perception that cost of college outweighs its benefits*

Retention Strategies:

- Show the real numbers: early, intentional education about the fiscal benefits of a engineering education – review salary surveys
- Introduce students to fiscally successful alumni by inviting to be guest lecturers during the Introduction to Engineering course seminar sessions.

Implementation of Retention Strategies

Beginning in Fall 2003, implementation of the afore mentioned strategies for retention began. Freshman attending the colleges preview are tracked through their academic progress.

Preview Attendance

From 2003 to the present.

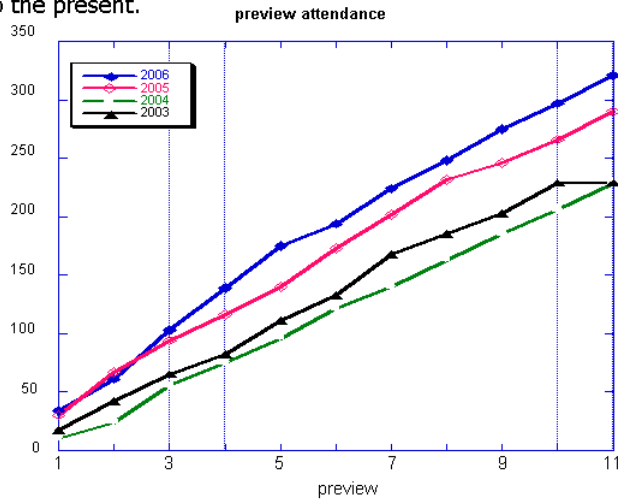


Exhibit 3, Freshman Preview Attendance January through December

Entering Freshman Data : 2005

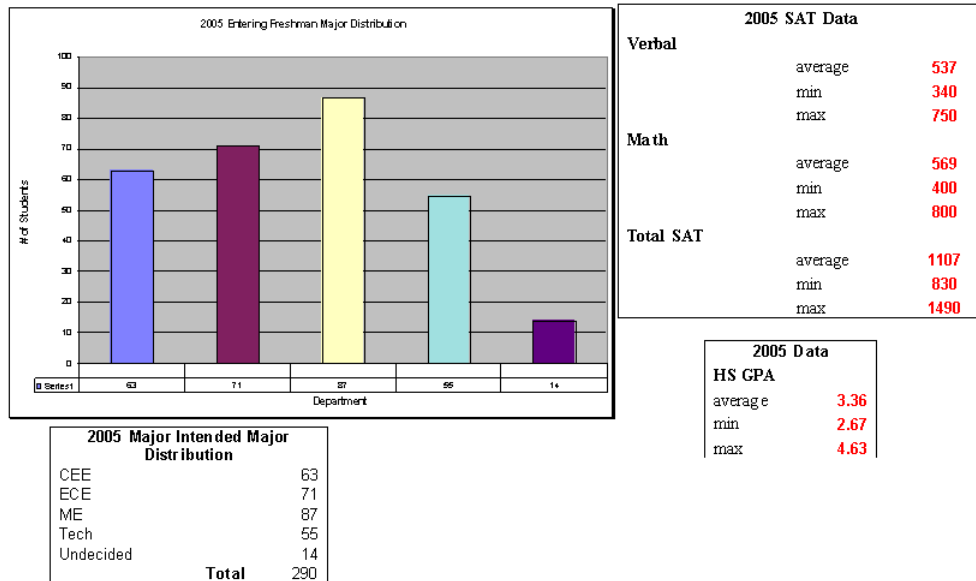


Exhibit 5, Entering Freshman Data, 2005

Declared Students, leaving EFD for Departments : 2005-06

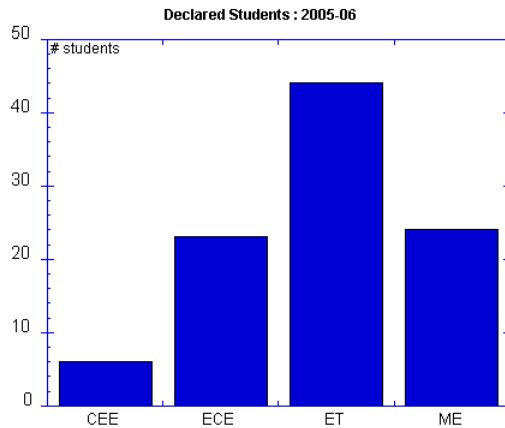


Exhibit 6, Declared Student Data

Conclusions

The freshman course sequence has provided an excellent opportunity for the EFD to interact with first year engineering students to address the issues related to student retention and allows the division to provide student guidance in determining the appropriate major that best satisfies their individual needs in choosing a career in Engineering and Engineering Technology. The engineering and technology modules concentrate on providing a meaningful team design experience in their disciplines, they also promote career opportunities in fields related to their disciplines, the importance of professional registration and opportunities for graduate study. One benefit for the College is that since engineering technology is shown to be a viable alternative for engineering students, fewer students are migrating from the College to other colleges, such as the College of Business and Public Administration. With these courses, full program participation, and increased advising efforts retention of students within the College is increasing. Implementation of the retention strategies has yielded modest results since their deployment (2003-04: retention 74%; 2004-05: retention 75%; 2005-06: retention 76%).

References

- ¹ Fink, F.K., "Integration of Engineering Practice into Curriculum – 25 Years of Experience with Problem Based Learning," Proceedings, 1999 Frontiers in Education Conference, <http://fie.engrng.pitt.edu/fie99/papers/1229.pdf>, accessed 10 March 2006.
- ² Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research*, 45(1), 89-125
- ³ National Resource Center for First Year Experience and Students in Transition. www.sc.edu/fye/
Accessed 25 January 06
- ⁴ Cueso, John. "Student Retention: Root Causes of Attrition & Systemic Strategies for Promoting Persistence," Marymount College (handout from Sue Saunders).
- ⁵ Barefoot, Betsy. "The First-year Experience: Are We Making It Any Better?" *About Campus* 4(6), Jan/Feb 2000, 12-18. www.earlycolleges.org/Downloads/FirstYear.pdf