

Helping First Year Students Make Critical Career Decisions

William K. LeBold, Heidi Diefes, William C. Oakes
Purdue University

Abstract

Beginning engineering students often need various degrees of help in making academic, career, and personal decisions that are likely to have a profound affect on their lives. Faculty, counselors, and staff responsible for first year engineering programs can play a critical role in helping students make these decisions. In this paper, we describe some of the programs developed at a large university (Purdue) to help beginning engineering students make academic, career, and personal decisions. Assessment data is presented on the relative strengths and weaknesses of the various programs.

I. Introduction

Academic advisement has consistently been criticized as one of the weakest services provided in higher education and engineering education:

“...advisement is one of the weakest links in higher education.”¹

“...academic advising is scandalously poor in higher education...advising of engineering students is worse than most.”²

“...quality of counseling, academic counseling and career guidance were rated the lowest of 30 undergraduate factors evaluated.”³

To improve its advising efforts, the Department of Freshman Engineering at Purdue University has developed a suite of courses and services to meet the diverse needs of its 1500-2000 beginning-engineering students. These programs and services are described below.

II. Purdue University Courses and Services

Day on Campus

Purdue students and their families participate in a Day On Campus program the summer before they begin their freshman studies. The daylong visit to campus includes a Freshman Engineering orientation meeting and an individual advising interview. During the orientation meeting, 70-100 students and their parents are provided with general information about Purdue's engineering program and resources. Particular attention is given to the first year plan-of-study and the requirements for admission into the engineering professional schools. In the Purdue system, engineering students are admitted into a single department, Freshman Engineering, and then matriculate to the engineering professional schools after completing the freshman requirements.

The individual advising interview is designed to help each freshman develop a personalized academic program tailored to the student's abilities and interests. The advising effort is carried out by a diverse advising staff that includes faculty, professional counselors, graduate students, peer undergraduate students, and support staff. Student abilities are accessed based on high school grades, SAT or ACT scores, and the results of AP exams, Purdue placement exams, and the a trigonometry and algebra test administered during Day on Campus. Students with notable difficulties in math are encouraged to strengthen their math skills by attending the Math Bridge program one week before classes begin. Other factors taken into account when advising students on course selections are: their tentative choice of engineering major, their level of comfort with entering the university setting, and their vision of their college career. One goal of the individual advising interviews is to enroll each student in a set of courses that strikes a balance between core courses and courses designed to foster their acclimation to college life and growth as engineers.

Open Counseling System

The Freshman Engineering counseling system is an open system that enables students to come in as walk-ins for counseling and advising. Students may choose to talk with on-duty faculty, professional counselors, graduate students, or undergraduate peer counselors. Students may also opt to make appointments with specific counselors and advisors.

Special efforts are made to coordinate academic counseling and courses for special groups of students. Contact between the Coordinator of the Honors Program and the Honors students begins with pre-college programs (STEP) and scholarship selection, and continues with registration and courses designed to meet their needs. High-risk students whose high school programs have given them inadequate preparation for engineering at Purdue are enrolled in courses designed to tutor and counsel them in math, chemistry, and physics. Female, international, and under-represented minority students may make appointments with faculty and staff whose expertise and responsibilities include programs in related areas. Students are also referred to counselors and coordinators in the professional schools with knowledge of specialized fields, scholarships, co-operative programs, and internship opportunities.

Purdue Interest Questionnaire

All beginning engineering students are administered the Purdue Interest Questionnaire (PIQ) in the first week of freshman seminar. Once results have been processed, a faculty member guides students in comparing their interests with past students and graduates who have majored in various engineering, science, technology, and management majors. PIQ profiles also provide students with an opportunity to compare their interests with engineers who have been employed in different engineering functions (research, development, design, operations, sales, and management) and with engineers who have pursued various types of post-baccalaureate programs.⁴ The PIQ profile becomes part of the student's file and may be used by the student and advisors for academic and career counseling.

ESCAPE

Purdue engineering students make use of ESCAPE - an Internet Engineering Specific Career Advisory Problem-solving Environment⁵ on the World Wide Web. The ESCAPE system has been developed to help students learn more about engineering as a career. A number of introductory computer and career related courses require that students find detailed information about engineering careers at this site.⁶ The site provides:

1. Descriptions of the different fields of engineering and their functions in society,
2. Information about organizations and publications typically read by various types of engineers, and
3. Current data on salaries, employment opportunities, employment sectors, and engineering demographics.

In addition, typical plans-of-study available at Purdue University are made available through ESCAPE so that students can pinpoint possible areas of success or difficulty.

Introduction to the Engineering Profession

In the fall semester, all beginning students are registered for Engineering 100 – an introduction to the engineering profession lecture series. Sections of 300-400 students meet once a week; each lecture focuses on a different field of engineering. The course is pass-fail with success based primarily on attendance. The information centers on the various fields of engineering and some of Purdue's specialized engineering programs (i.e. Land Surveying, Interdisciplinary Engineering, Agricultural and Biological Engineering, and Cooperative Education).

While much information is made available to the student through Engineering 100, the student's role in the course is passive. To provide students with a more active role in their academic, career, and life planning, a suite of courses has been developed to meet the needs of Purdue's diverse student body. These courses supplement the Engineering 100 experience and provide a small group setting conducive to student interaction. Several different models of the supplemental courses are offered and each is detailed below. The students are not required to take a supplemental course, but approximately half of the incoming freshmen do choose at least one of the options with a small percentage taking more than one.

Introduction to the Engineering Profession Supplement Courses

Freshman Engineering offers two small group discussion courses that supplement ENGR 100. Engineering faculty members lead and teach ENGR 195D. Upper-division engineering students, under the direction of a faculty member, lead and teach ENGR 195F. Students in these courses earn a grade of A-F based on attendance, participation, and completion of assignments.

In ENGR 195D, faculty members meet with groups of approximately 30 students for one hour each week and actively engage students in career related experiences. This instructor-led course involves the student in resume writing, job fairs, career planning, internet searches for career and academic information, ethics games, communication exercises, and engineering problem solving. This course has been well received by students.⁷

In ENGR 195F, two upper-class-engineering students lead discussion groups of 16 students. The student-led groups also cover resume writing and encourage participation in a job fair. However, the emphasis of this course is more on acclimation to college life; discussion centers on course selections, social life, studying, and student services and organizations.

Special Groups Course Offerings

Women in Engineering Seminar (ENGR 194) is a one-credit hour course that meets two hours per week. Seminars feature guest women role models. A written assignment takes the form of a short paper on the student's career plans or a weekly journal on the student's progress at Purdue. This course also puts students in contact with upper-class mentors who meet with students periodically during the semester.

Orientation Seminar for Minority Engineering Students (ENGR 180) is a one-credit hour course that meets two hours a week and features both campus and outside speakers. The goal of this course is to aid minority students in making the adjustment to the college environment while exploring career opportunities.

Engineering Problem Solving (ENGR195T) is a one credit hour honors course that focuses on the fundamentals of problem solving. During the weekly one-hour lecture and one-hour laboratory, students receive a broad-based education in topics of concern to engineers (e.g. statistics, engineering economics, material balances, statics, and energy).

Engineering Career Planning (ENGR 185) is a one credit hour course of eight weeks duration that includes a two-hour laboratory and an hour arranged for counseling and projects. Students are assisted in planning for their educational, career, and personal development.

Engineering Schools Course Offerings

Four of the smaller engineering professional schools offer a freshman level one- or two-credit hour introductory course that is designed to provide young engineers with a greater understanding of a particular discipline. The School of Aeronautics and Astronautics offers Introduction to Aerospace Engineering (A&AE 190) provides an introduction to aerospace engineering problem solving methods and design. Agricultural & Biological Engineering's introductory seminar series (ABE 210) introduces freshman to the three department disciplines: Food Process Engineering, Machine Systems Engineering, and Environmental and Natural Resources Engineering. Nuclear Engineering offers Introduction to Energy Engineering (NUCL 497A); this course looks at the history, social, and environmental impact of energy use and the role of the engineers, and in particular nuclear engineers, in solving energy problems. Introduction to Materials Engineering (MSE 190) introduces students to Materials Science and Engineering. Emphasis of the course is on processing, structure, properties, and performance of materials including ceramics, polymers, composites, and electronic materials.

Counselor-Tutorial Course Offerings

A series of tutorial assistance courses are available for high-risk students. On an as-needed basis, supplementary instruction is offered in math, general chemistry, and physics. In addition, high-risk students have been required to take a one-credit hour computer course designed for co-enrollment in remedial math courses.

III. Evaluation

To provide some insight on the effectiveness of the various programs, a number of evaluative techniques are employed. Surveys related to the content of the specific courses are used to provide formative and summative evaluation data. In addition, summative data is collected using an optical scan 500-item Pre-Engineering Evaluation Survey that is completed by approximately 90% of the beginning engineering students at the end of the first semester. This survey provides student input and ratings of courses and services offered by Freshman Engineering and Purdue University. These data also provide comprehensive comparative data on the suite of courses offered to beginning engineering students.

The results of these student perceptions and ratings for the special career related courses are given in Tables 1 and 2 and Figures 1 and 2. Tables 1 and 2 present the results of the related summative survey data of students who participated in the special courses in 1996 and 1997, respectively. All the special courses received higher ratings than the control group (students enrolled in ENGR 100 who did not participate in any of the special courses or programs). There was some synergetic effects in that a higher percentage of the students in many of the special courses rated other services (e.g. registration, academic advising, faculty-student contact) higher than the control groups. However, in some cases, the ratings of some services were lower for students who participated in special courses versus students who did not participate.

Figure 1 shows composite 1996-97 data on key items related to academic advising for the faculty-led (ENGR 195D) and student-led (ENGR 195F) supplementary courses and the control (ENGR 100) course. Students in the Faculty-led course tended to give higher ratings on key items than students in the Student-led and control courses. However, Academic Advising and Career Counseling still did not receive significantly higher ratings.

Figure 2 indicates that students who participated in the Honors Program (ENGR 100H) and the Career Development (ENGR 185) course in 1996 did give significantly higher ratings to both Academic and Career Counseling than students in the control course who did not participate in any of the special courses. The relatively high rating of Academic Advising by students in the Honors program is attributed to (1) the close relationship developed between the Coordinator of the Honors Program and Honors students in pre-college programs, registration, special honors courses, and (2) the recognition of Honors students academic achievements. The relatively high Career Counseling rating by students in the Engineering Career Development is due to the pro-active career related content of this course.

IV. Summary and Conclusions

This paper summarizes some of the efforts made at a large public university (Purdue) to help a diverse student body make critical career decisions. This includes an open counseling system

with both individual and group counseling. The comprehensive counseling system includes the use of a specialized engineering interest inventory (PIQ) and a World Wide Web engineering career information system (ESCAPE). A suite of courses designed to meet the special needs of women, under-represented minorities, honors students, and high-risk students as well as undecided students are offered. Courses led by faculty or students are also offered for students who may not have any special needs, but seek additional help in making career related decisions.

Valuable formative and summative evaluation data are obtained to provide information on the strengths and weaknesses of various courses. A comprehensive summative evaluation system is in place to not only evaluate courses and services provided to beginning engineering students, but also provides detailed assessment data on the relative effect of various programs and services. The optimum system for helping students make critical career decisions requires not only a comprehensive information system, but one that combines group and individual counseling. Freshman Engineering has a special responsibility to provide courses and services that help engineering students make critical decisions that have a significant impact on their career and lives. Significant progress to this end has been made, but there is still work to be done to make counseling and advising more pro-active.

Bibliography

1. Study Group, *Report on Excellence in Undergraduate Education*, Chronicle of Higher Education, (1984).
2. Association of American Colleges, *Unfinished Design-the Humanities and Social Science in Engineering Education*, Washington, D.C., (1988).
3. Engineering Manpower Commission, *Toward the More Effective Utilization of American Engineers*, Washington, D.C., (1986).
4. Shell, K.D., LeBold, W.K., and Ward, S.K. "The Purdue Interest Questionnaire: Helping Engineering and Technology Students Make Career Decisions," *ASEE-IEEE Frontiers in Education Proceedings*, 482-452, (1991).
5. URL: <http://www.ecn.purdue/ESCAPE>; ESCAPE - Engineering Specific Career Advisory Problem-Solving Environment.
5. LeBold, W.K., Perry, J., and Ward, S.K. "ESCAPE through the Internet." *ASEE-IEEE Frontiers in Education Proceedings*, (1994).
6. Hopper, M.E., LeBold, W.K., and Feghali, A.A. "A Hypermedia-Based Problem-Solving Approach to Engineering, Learning and Playing," *ASEE-IEEE Frontiers in Education Proceedings*, 73-4. (1991).
7. Hatton, D.C., Wankat, P.C., and LeBold, W. K., The Effects of an Orientation Course on the Attitudes of Freshman Engineering Students, *Journal of Engineering Education*, January, (1998).

WILLIAM K. LEBOLD

William K. Lebold is the Purdue Director of Educational Research and Information Systems and a Professor of Engineering. He has pioneered in the development of assessment methods personalizing the educational and career development of engineering students and graduates. He received the 1989 Purdue Alumni "Helping Students Learn" Award for his work on optimal placement of beginning students in math, chemistry, and physics. He also developed PIQ, Computer Development Self-Appraisal survey, and ESCAPE. Bill currently serves as a commissioner of the AAES Engineering Workforce commission and is chair of the ASEE Academy of Fellows. He

received the 1991 ASEE Distinguished Service Citation and the 1992 IEEE Education Society Meritorious Service Award. Bill has been chair of the ASEE-ERM and Information Systems History and Production Committees and played a key role in the development of the Freshman Engineering Division. He served as the Project Coordinator of the ASEE Goals of Engineering Education Study. Bill received his B.S. and M.S. degrees in electrical engineering from Minnesota and Northwestern, respectively, and his Ph.D. in psychology from Purdue.

HEIDI A. DIEFES

Heidi A. Diefes is a Visiting Assistant Professor in the Departments of Freshman Engineering and Agricultural & Biological Engineering at Purdue. She received her B.S. and M.S. in food science from Cornell University and her Ph.D. in food process engineering from Purdue. She was a recipient of the 1996 Apprentice Faculty Grant from the Educational Research and Methods (ERM) division of ASEE. She served as the president of Purdue's ASEE student chapter from 1995-1996.

WILLIAM C. OAKES

William Oakes is an assistant professor in the department of Freshman Engineering at Purdue University. He also serves as a co-director of the Engineering Projects in Community Service (EPICS) program. He received his Ph.D. from the School of Mechanical Engineering at Purdue University in 1997. Before coming to Purdue, he worked as a design engineering for GE Aircraft Engines in Cincinnati, Ohio. He attended Michigan State University for his BSME (1985) and his MSME (1987). His research interests are in the area of turbomachinery and in educational assessment. He is an active member of ASEE serving as an adviser to the Purdue Student chapter and on the board of the Freshman Programs Division. He was a recipient of 1993 ASME Graduate Teaching Fellowship and the 1997 Apprentice Faculty Grant from the Educational Research and Methods (ERM) division of ASEE.

Table 1. Percent rating as "Excellent" or "Good" by students in various orientation-counseling courses (1996).

RESOURCE/SERVICE	TOT	ENGINEERING COURSE							Sig.
		100	100H	195D	195F	180	194	185	
Purdue in General	84	84	87	84	82	76	87	100	.503
Fr Engr in General	66	64	76	71	58	64	64	71	.120
Academic Climate	65	62	80	69	60	60	72	71	.044
Spring Registration	64	62	75	76	59	68	55	71	.001
Fall Registration	66	64	81	73	61	67	56	60	.008
Courteous & Friendly	68	67	81	70	67	67	53	83	.020
Overall Pre-Engr Program	78	76	90	81	74	76	78	83	.169
Freshman Engr Lectures	64	58	76	81	65	48	60	43	.000
Academic Advising	48	45	70	53	46	53	40	67	.003
Career Counseling	39	39	44	38	37	38	44	60	.906
Help Select Engr Major	40	37	53	48	38	38	34	20	.077
Faculty-Student Contact	36	33	58	34	43	44	33	80	.001
Help Select Non-Engr Major	29	29	15	26	34	33	32	0	.666
Special Courses	NA	58	76	81	65	80	86	71	NA
No. of Cases	1230	645	72	245	145	25	83	7	NA

100 - Freshman Lectures; 100H - Freshman Lectures-Honors; 195D -Faculty Led Groups; 195F- Student Led Groups; 180 - Minority in Engineering Seminar; 194 - Women in Engineering Seminar; 185 - Special Engineering Career Development Computer Course.

Table 2. Percent rating as "Excellent" or "Good" by students in various orientation-counseling courses (1997).

RESOURCE/SERVICE	'97 TOT	ENGINEERING COURSE										
		100	100H	195D	195F	180	194	191C	192C	191M	116	195S
Purdue in General	90	90	88	90	90	86	91	100	98	90	89	91
Fr Engr in General	65	64	84	61	46	59	63	67	73	63	87	66
Academic Climate	69	67	81	63	64	51	67	67	66	66	84	66
Spring Registration	70	69	72	71	60	58	65	89	79	70	77	69
Fall Registration	66	65	77	65	51	57	64	89	80	67	81	58
Courteous & Friendly	74	72	82	79	67	71	71	89	80	69	79	69
Overall Pre-Engr Program	75	75	92	63	67	75	72	80	72	66	91	67
Freshman Engr Lectures	49	48	47	52	61	38	40	22	54	42	47	43
Academic Advising	50	48	56	55	46	49	41	56	62	53	70	52
Career Counseling	41	42	48	41	33	40	41	57	45	43	51	43
Help Select Engr Major	40	38	55	44	33	36	38	57	40	39	54	50
Faculty-Student Contact	40	38	46	40	36	25	34	44	48	42	50	41
Help Select Non-Engr Major	33	32	41	35	40	21	33	50	31	36	39	37
Special Courses	NA	47	47	67	75	68	84	100	90	53	58	68
No.of Cases	1212	930	140	145	30	21	98	8	32	80	31	86

100 - Freshman Lectures; 100H - Freshman Lectures - Honors; 195D - Faculty Led Groups; 195F - Student Led Groups; 180 - Minority in Engineering Seminar; 194 - Women in Engineering Seminar; 191C - Help in Ch 111; 192C - Help in Ch 115; 192M - Help in Ma 151; 116 Honors Computer Tools Course; 195S - Computer Help Course

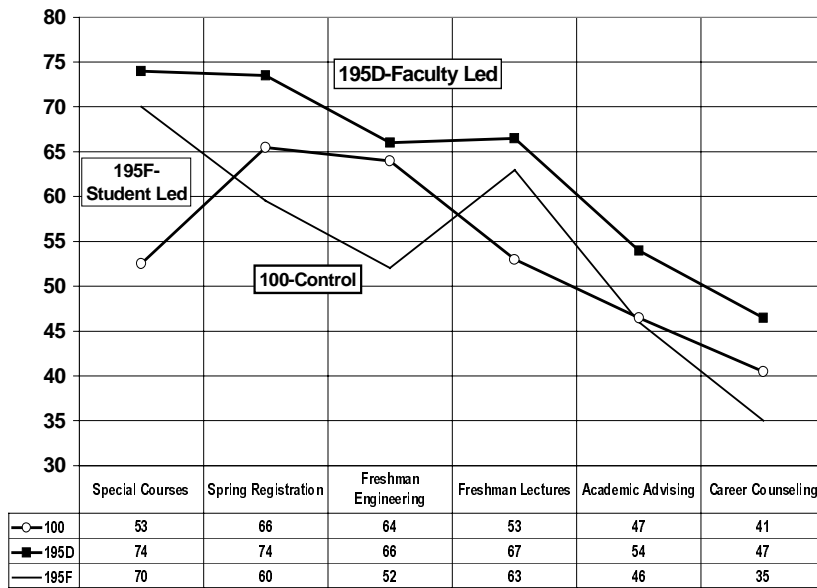


Figure 1. Percent of "Excellent and Good" ratings of students on key items who participated in Faculty-Led, Student-Led, and Control Courses in 1996 and 1997.

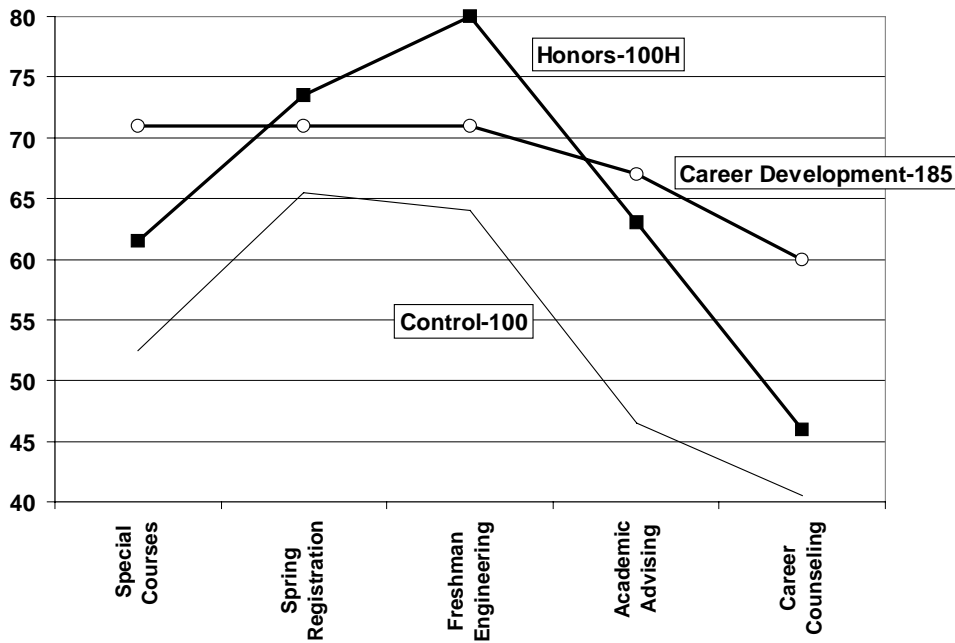


Figure 2. Percent of "Excellent and Good" ratings on key decision-making survey items by students who participated in an Integrated Honors Program and an Engineering Career Development course.