Are Attitudes Toward Engineering Influenced by a Project-Based Introductory Course?

Jean Nocito-Gobel, Michael A. Collura, Samuel Daniels, Ismail I. Orabi
School of Engineering & Applied Science, University of New Haven

Abstract

Like most engineering schools, the School of Engineering and Applied Science at the University of New Haven (UNH) offers a first year Introduction to Engineering course (EAS107). Unlike similar courses at most other schools, however, EAS107 is also part of the UNH core curriculum and is taken by many students who are not studying engineering, thus providing an opportunity to influence these students' perception of engineering.

As part of a new curricular model for our engineering students, the ***Multi-Disciplinary Engineering Foundation Spiral,*** this course has been transformed from a traditional delivery mode to a project-based format. One of the primary objectives of changing the course is to improve retention of engineering students by giving them the opportunity to do hands-on engineering activities during their first semester. There is concern, however, about how the non-engineering students will respond to the new format.

During the fall 2003 semester we offered 2 sections of EAS107 in the project format - one with only engineering freshmen and one with a mix of students from various majors. In addition, four other sections of EAS107 were offered using the traditional delivery mode. During the fall 2004 semester we offered 3 sections of EAS107 in the project format with a mix of students from engineering and other majors, and 3 sections using the traditional delivery mode consisting entirely of other majors. Student perceptions of the engineering profession and of their preparation to study this field were assessed at the beginning and at the end of the course using a survey instrument.

This paper presents results of the survey in an attempt to answer the following questions:

Does a misconception about engineering lead some students to select other majors?
How are engineering students` attitudes affected by a project-based introductory course?
What is the effect of a heterogeneous class on student attitudes?
What are the primary influences in students' choice of a major?

Initial attitudes are examined to determine differences by gender, age and major. Changes in attitudes are tracked with regard to course delivery mode and mix of students in the class.

Introduction

The University of New Haven (UNH) in 2003 embarked on a major reform of their undergraduate curriculum, resulting in the development of a new curricular approach referred to as the ***Multidisciplinary Engineering Foundation Spiral***[1]. This curricular model is a four-semester sequence of engineering courses, matched closely with the development of students' mathematical sophistication and analytical capabilities and integrated with coursework in the sciences. The courses in this new curriculum utilize active and cooperative learning techniques to engage students in the learning process.

Beginning first semester freshman year, engineering students are enrolled in a Project-based Introduction to Engineering course. This course is unlike introductory level engineering courses offered at other institutions in that it is part of the UNH core curriculum and as such is taken not only by engineering majors, but also by students who are not studying engineering[2]. This provides faculty with the opportunity to influence students' perceptions about engineering, which otherwise would not necessarily be exposed to engineering. The project-based course is one of the first courses taken by engineering students in the new curriculum in which students are introduced to engineering concepts using projects and hands-on-activities. Non-engineering majors have the option to take the project-based course or the more traditional version of this course. When the project-based course was introduced into the curriculum, there was concern as to how non-engineering students would respond to the new format of the course.

Background: Use of Surveys

The value of using surveys of engineering attitudes to help institutions evaluate their freshman engineering programs has been documented[3,4]. Surveys provide the advantage of gathering feedback from a large number of students in a relatively easy manner. The assessment plan for the first year of the Multidisciplinary Engineering Foundation Spiral includes the use of an Engineering Attitudes Survey to assess specifically the Project-based Introduction to Engineering course. Because non-engineering majors also take this course, the survey allowed us to gather information about students who are interested in science-related fields and yet did not choose engineering as a major.

The purpose of the Engineering Attitudes Survey was to assess students' perceptions of the engineering profession and of their preparation to study this field. Questions in the survey were structured so as to provide information that we could use not only to evaluate the progress of our engineering students in the new curriculum, but also to help us better understand factors that may contribute to why students interested particularly in science related fields are not choosing engineering. The survey tool will help us to assess how engineering students' attitudes are affected by a project-based introductory engineering course, and the effect of a heterogeneous class on student attitudes. Results of the survey will also be used to help us answer questions related to the choice of major specifically whether misconceptions about engineering lead some students to select other majors, and the primary influences in students' choice of major. The survey instrument was administered twice to students during the 2003 and 2004 fall semesters, once at the beginning (pre-survey), and again at the end (post-survey) of these semesters.

Survey Tool

The survey instrument used is a modification of the Pittsburgh Freshman Engineering Attitude Instrument[©3], a tool first developed and tested at the University of Pittsburgh. This questionnaire has been administered at the University of Pittsburgh since 1993 and has been used as a standard evaluation instrument for several years at other institutions including the University of Texas – El Paso and the North Carolina State University[4]. Several aspects of student attitudes are measured using the survey including reasons for studying engineering, understanding of the engineering profession, an assessment of students' confidence in background skills, and opinions regarding their ability to succeed in engineering. Because the Pittsburgh Freshman Engineering Attitude Instrument© was developed specifically to evaluate engineering student attitudes, the questionnaire needed to be modified to reflect the opinions of non-engineering students taking the Intro to Engineering course. Questions were added to assess students' understanding of engineering.

The Pittsburgh Freshman Engineering Attitude Instrument© served as a template for the Engineering Attitude Survey discussed in this paper. Information gathered in the Engineering Attitude Survey included student number, major, section of Intro to Engineering course, semester course taken, gender, age, class rank, student status and ethnicity. Questions in the Pittsburgh Freshman Engineering Attitude Instrument© related to the student's choice of engineering as a major were reworded to reflect any major. The modified survey consisted of 36 questions compared with 50 questions in the Pittsburgh questionnaire. These questions were then grouped into 13 separate student attitude and self-assessment measures, and further reduced to 4 groups for analysis. The Engineering Attitude Survey is included in Appendix A. Four groups define the broad areas that were measured: attitude toward the engineering profession; understanding of engineering; interest in technical professions; and confidence in abilities (see Table 1). Each group included 5 to 12 separate questions. The questions were classified in categories as shown in Table 2. The rating used for categories 1-7, and 10-13 ranged from strongly disagree to strongly agree, while the rating used for the competency categories, 8 and 9, ranged from very unsure to very confident.

Table 1: Groups Defined in Engineering Attitude Survey

		Areas Measured	**No. of Questions**
Group	A	Attitude toward the Engineering Profession	9
Group	B	Understanding of Engineering	5
Group	C	Interest in Technical Professions	5
Group	D	Confidence in Abilities	12

Analyses Performed

The analysis was conducted in two parts. First, the pre-surveys administered at the beginning of the semester were used alone to determine whether there were any differences in student's attitudes toward engineering and confidence in skills based on their choice of major; specifically Engineering, Science and other majors. Science majors included students in Chemistry, Computer Science, Forensic Science, Biology and Fire Science. The second part of the analysis used the pre-and post-survey results to determine whether there were any significant differences in students' attitudes based on course modality; namely Project-based vs. non-project based version of Intro to Engineering.

Table 2: Categories Used in Engineering Attitude Survey

		Student Attitude & Self Assessment Measures	Group	Questions*
Category	1	General Impressions of Engineering	A	1,2,3,5
Category	2	Financial Influences for Studying Engineering		11, 14
Category	3	Perception of How Engineers Contribute to Society	A	10, 17
Category	4	Perception of Work Engineers Do and the Engineering Profession	A	4, 8, 16
Category	5	Enjoyment of Math and Science	C	6
Category	6	Accurate Understanding of Engineering Work	B	9, 12, 13, 15, 20
Category	7	Family Influence in Selecting Major		7
Category	8	Confidence in Basic Engineering Knowledge and Skills	D	29, 30, 31, 32, 33
Category	9	Confidence in Communication and Computer Skills	D	34, 35, 36
Category	10	Adequate Study Habits	D	23
Category	11	Affinity for Teamwork		21, 25
Category	12	Problem-solving Ability	D	22, 24, 27
Category	13	Affinity for Technical Work	C	18, 19, 26, 28
* Individual questions listed in survey in Appendix A.				

Data collected during the fall 2003 and 2004 semesters were used in the analysis. During the fall 2003 semester we offered 2 sections of EAS107 in the project format - one with only engineering freshmen and one with a mix of students from various majors. In addition, four other sections of EAS107 were offered using the traditional delivery mode. During the fall 2004 semester we offered 3 sections of EAS107 in the project format with a mix of students from engineering and other majors, and 3 sections using the traditional delivery mode consisting entirely of other majors. Pre- and post-surveys were administered at the beginning and at the end of the course. A total of 167 students completed the pre-surveys with only 155 completing the post-surveys. This difference is primarily due to the fact that pre-surveys were administered to students in some of the chemistry classes who did not take the Intro to Engineering course during these semesters. These students were added to augment the number of first year students in Science majors. In addition, there were a few students who were absent when the survey was administered at either the beginning or end of the semester.

Statistical analysis of the data was performed using the software package SPSS. This statistical package allows the user to perform hypothesis testing to determine the p-statistic at which there is a possibility that the hypothesis is false. Using SPSS, student t-tests are performed to test the hypothesis in all cases of whether the mean value for a particular response or grouping of responses is the same or is statistically different. Part 1 of the analysis focuses on gaining insight into whether students' conceptions about engineering correlate with their choice of major. In Part 1, SPSS is used to determine whether there is a statistical difference between the responses of Engineering students compared with Science or other majors to the following questions:

- Does student confidence in his/her skills, namely math, chemistry, physics and computer, differ depending on major, specifically Engineering, Science or other major?

- Do students' attitudes toward engineering (Category A questions) differ depending on major?
- Do students understand the difference between the work done by Engineers and Scientists (Question 15)?
- Do students understand the requirements for a practicing engineer (Question 9)?
- Do students who enjoy math and science necessarily choose Engineering as a major (Question 6)?
- Does class rank, gender, or student age affect the attitudes of non-engineering students (both Science and other majors)?

Part 2 of the analysis focuses on assessing whether the project-based Intro to Engineering course impacts students' attitudes toward engineering. The chance in students' attitudes between the surveys administered at the beginning (pre-survey) and end of the semester (post-survey) are used to evaluate whether the modality of the Intro to Engineering course influences their attitudes. SPSS is used to determine whether there is a statistical difference between students in the project-based and non-project-based course with regards to the following:

- Attitude toward the Engineering profession (Group A questions)
- Understanding of Engineering (Group B questions)
- Interest in Technical Professions (Group C questions)
- Confidence in abilities (Group D questions).

For the student t-test performed using SPSS, the mean of the pre-survey results for a particular group of students is compared with the mean of the post-survey results for that same group. Because the analysis is performed on the means of the pre-survey and post-survey results, this analysis is conducted for engineering majors alone and for non-engineering majors alone. Differences between engineering and non-engineering majors pre-survey results indicate large enough differences exist that would skew the mean value if the two groups were combined.

Results and Discussion

Prior to conducting any analysis, student t-tests are performed using the pre-test results to ensure that the groups are comparable. A significance level of 0.05 or less would mean that there is 95% confidence or greater that the means of particular groups are statistically different. Summarized in Tables 3 and 4 are the results of student t-tests to compare the means of engineering majors in the project-based and non-project-based sections for each of the four groups listed in Table 1, and means of engineering majors who were in either section in Fall 2004 with those in Fall 2003, respectively. As indicated in Tables 3 and 4, sampling of students based on course modality or year the course was taken are statistically identical for Groups A through D since the p-statistic in all cases is greater than 0.05.

Similar analyses were performed using the pre-surveys for the non-engineering majors. Summarized in Tables 5 and 6 are the results of student t-tests to compare the means of non-engineering majors based on course modality, and means of non-engineering majors who were in either section in Fall 2004 with those in Fall 2003, respectively. In contrast to engineering majors, there are two cases where the means are statistically different. For non-engineering

Table 3: Student t-Test Results Comparing the Means of Engineering Majors Based on Course Modality

Comparison of Means of Engineering Students in Project-Based & Non-Project-Based Sections			
	Non-Project	**Project**	
Students in Survey:	21	53	
	Mean		**Signific.**
Attitude	4.1	4.3	0.164
Understand	3.9	3.9	0.686
Interest	4.2	4.2	0.633
Confidence	3.4	3.5	0.546

Table 4: Student t-Test Results Comparing the Means of Engineering Majors Based on Year Course Taken

Comparison of Engineering Students in Fall 2003 and Fall 2004			
	Fall 2003	**Fall 2004**	
Students in Survey:	37	37	
	Mean		**Signific.**
Attitude	4.3	4.2	0.512
Understand	3.8	3.9	0.311
Interest	4.3	4.2	0.261
Confidence	3.5	3.4	0.131

majors, the sampling of students based on course modality was not statistically identical for questions pertaining to interest in engineering. The limited sample size for those majors taking the project-based course may contribute to this difference. However, the primary reason for this difference is probably linked to the reason why non-engineering majors take the Intro to Engineering course. For many students, the choice of this course fulfills a core curriculum requirement. Those students who choose the project-based course do so because they are interested in learning about engineering.

When non-engineering majors are compared based on the year they took the course regardless of modality, sampling of students based on their attitudes toward engineering are not statistically identical. A reason for this difference may be linked to the notable difference in the number of non-engineering majors who took the Intro to Engineering courses in Fall 2004. During Fall 2004, students were aware of the distinction in the modality of this course. Fewer non-project based versions of Intro to Engineering were offered with multiple sections of the project-based course. Because students were aware of this distinction with less sections of the non-project-based course available, they may have delayed taking the course resulting in fewer non-engineering majors in the 2004 sections. Those non-engineering majors who were in either section of the course appear to have a more positive attitude toward engineering. The results of this validity check on the data will taken into account in the interpretation of the subsequent statistical analyses performed.

Table 5: Student t-Test Results Comparing the Means of Non-Engineering Majors Based on Course Modality

Comparison of Means of Non-Engineering Students in Project-Based & Lecture-Based Sections			
	Non-Project	**Project**	
Students in Survey:	80	12	
	Mean		**Signific.**
Attitude	3.8	4.0	0.125
Understand	3.6	3.6	0.549
Interest	3.2	3.6	**0.043**
Confidence	3.1	3.3	0.406

Table 6: Student t-Test Results Comparing the Means of Non-Engineering Majors Based on Year Course Taken

Comparison of Non-Engineering Students in Fall 2003 and Fall 2004			
	Fall 2003	**Fall 2004**	
Students in Survey:	59	34	
	Mean		**Signific.**
Attitude	3.7	3.9	**0.041**
Understand	3.6	3.6	0.956
Interest	3.2	3.3	0.471
Confidence	3.1	3.2	0.471

The first part of the analyses focused on gaining insight into whether students' conceptions about engineering correlate with their choice of major. Student t-tests were performed to determine whether the means of engineering majors compared with non-engineering majors were statistically different for each of the 4 major groups and 13 categories listed in Tables 1 and 2. A comparison of pre-survey results based on major is summarized in Table 7. These results are based on sample sizes of 73 engineering majors, 20 science majors, and 74 other non-engineering majors. As indicated in Table 7, for the 4 major groups namely; student attitudes toward engineering profession, their understanding of engineering, interest in technical

Table 7: Comparison of Pre-Survey Results Based on Major

Comparison of Pre Survey Results								
	Engineers vs. Other Majors		Engineers & Science vs. Other Majors		Engineer vs. Science		Engineers vs. Others Except Science	
	Mean	Signific.	Mean	Signific.	Mean	Signific.	Mean	Signific.
Attitude	3.8	0.000	3.8	0.000	4.2	0.000	3.8	0.000
	4.2		4.1		3.8		4.2	
Understand	3.6	0.000	3.6	0.000	3.9	0.134	3.6	0.000
	3.9		3.9		3.7		3.9	
Confidence	3.1	0.000	3.1	0.000	3.5	0.005	3.1	0.000
	3.5		3.4		3.2		3.5	
General Impressions of	3.8	0.000	3.8	0.000	4.4	0.000	3.8	0.000
	4.4		4.3		3.9		4.4	
Financial Influences for	2.7	0.000	2.7	0.047	3.1	0.001	2.7	0.003
	3.1		2.9		2.5		3.1	
Perception of Engineering contribution to society	3.9	0.097	3.9	0.316	4.0	0.199	3.9	0.151
	4.0		4.0		3.8		4	
Perception of work of engineers	3.8	0.000	3.8	0.000	4.3	0.000	3.8	0.000
	4.3		4.1		3.7		4.3	
Enjoyment of math & science	2.7	0.000	2.5	0.000	3.9	0.016	2.5	0.000
	3.9		3.8		3.3		3.9	
Accurate understanding of engineering work	3.6	0.000	3.6	0.000	3.9	0.134	3.6	0.000
	3.9		3.7		3.7		3.9	
Family Influences for choice of major	2.0	0.036	2.1	0.126	2.4	0.149	2.1	0.058
	2.4		2.3		2.0		2.4	
Confidence in Engineering knowledge	2.7	0.000	2.6	0.000	3.7	0.004	2.6	0.000
	3.7		3.6		3.1		3.7	
Confidence in communications & computers	3.8	0.795	3.8	0.894	3.8	0.777	3.8	0.841
	3.8		3.8		3.8		3.8	
Adequate study habits	2.6	0.422	2.6	0.597	2.5	0.622	2.6	0.477
	2.5		2.5		2.6		2.5	
Affinity for Teamwork	2.9	0.096	2.9	0.358	2.8	0.114	2.9	0.180
	2.8		2.8		3.0		2.8	
Problem-solving ability	3.5	0.000	3.5	0.000	4.0	0.000	3.5	0.000
	4.0		3.8		3.4		4	
Affinity for technical work	3.4	0.000	3.3	0.000	4.3	0.000	3.3	0.000
	4.3		4.1		3.7		4.3	

professions and confidence in abilities, all are statistically different for non-engineering and engineering majors. However, the understanding of engineering by science majors is statistically identical to engineering majors.

It is interested to note that students' perception of how engineers contribute to society (Category 3), confidence in their communication and computer skills (Category 9), adequate study habits (Category 10) and affinity for teamwork (Category 11) are all statistically identical for engineering and non-engineering majors. However, their general impressions of engineering (Category 1), financial influences for studying engineering (Category 2), perception of work done by engineers (Category 4), confidence in engineering knowledge (Category 8), problem solving ability (Category 12) and affinity for technical work (Category 13) are all statistically different dependent on major; that is engineering versus non-engineering major. Family influences for studying engineering (Category 7) are dependent on major when engineers are compared with other majors, but not science majors.

Student's enjoyment of math and science (Category 5) was statistically different depending on major, even when engineers were compared with science majors. There was a significant difference between the means for the engineering majors compared with the science majors; namely 0.6. Considering that the engineers confidence in engineering knowledge which includes confidence in chemistry, physics, calculus, engineering subjects and computer analysis skills is also statistically different than science majors, this may suggest that it is a lack of confidence or enjoyment of math that influences science majors not to major in engineering.

Students having an accurate understanding of engineering work (Category 6) is statistically different when engineers are compared to all other non-engineering majors. However, this is not true when engineers are compared with science majors. To gain further insight, student t-tests were performed for specific questions in Category 6.

These results suggest that a student's confidence in their skills; namely, math, chemistry, physics and computer analysis does differ depending on major, as well as their attitude toward the engineering profession. Although science majors' understanding of the engineering profession is not statistically different than the engineering majors, their attitude and confidence in their abilities may contribute in some way as to why they do not choose engineering as a major.

Comparison of Pre Survey - non-engineering students									
	Gender			Class Rank			Age		
	Mean		Signific.	Mean		Signific.	Mean		Signific.
	Male	Female		< 2	>=2		< 20	>=20	
Attitude	3.8	3.9	0.402	3.7	3.8	0.227	3.9	3.8	0.258
Understand	3.5	3.8	**0.005**	3.7	3.6	0.295	3.6	3.6	0.998
Interest	3.3	3.2	0.501	3.3	3.2	0.686	3.4	3.2	0.37
Confidence	3.0	3.3	**0.038**	3.2	3.1	0.764	3.0	3.1	0.542
General Impressions of	3.7	3.9	0.294	3.7	3.8	0.459	3.9	3.8	0.517
Financial Influences for	2.7	2.6	0.861	2.6	2.6	0.805	2.7	2.6	0.635
Perception of Engineering contribution to society	3.9	3.9	0.623	3.8	3.9	0.278	4	3.9	0.627
Perception of work of engineers	3.7	3.9	0.201	3.6	3.8	0.311	4	3.7	0.047
Enjoyment of math & science	2.6	2.8	0.513	3.0	2.6	0.254	2.5	2.6	0.842
Accurate understanding of engineering work	3.5	3.8	**0.005**	3.7	3.6	0.295	3.6	3.6	0.998
Family Influences for choice of major	2.2	1.8	0.097	1.9	2.1	0.55	2.4	1.9	0.096
Confidence in Engineering knowledge	2.7	2.8	0.774	2.9	2.7	0.333	2.7	2.7	0.857
Confidence in communications & computers	3.6	4.0	**0.005**	3.7	3.8	0.745	3.7	3.8	0.635
Adequate study habits	2.3	2.9	**0.025**	2.8	2.6	0.503	2.3	2.7	0.113
Affinity for Teamwork	3.0	2.8	0.216	3.1	2.8	0.102	2.8	3	0.494
Problem-solving ability	3.5	3.4	0.407	3.4	3.5	0.367	3.5	3.4	0.62
Affinity for technical work	3.5	3.3	0.218	3.4	3.4	0.952	3.6	3.3	0.203

Comparison of Post to Pre Survey, non-engineering students in Project-Based vs. Non-Project Based Course						
	Project-Based			Non Project-Based		
	Pre	Post		Pre	Post	
Students in Survey:	12	8		81	87	
	Mean		Significance	Mean		Significance
Attitude	4.0	4.0	0.895	3.8	3.8	0.868
Understand	3.6	3.8	0.128	3.6	3.5	**0.075**
Interest	3.6	4.0	0.087	3.2	3.4	0.095
Confidence	3.3	3.3	0.719	3.1	3.3	**0.025**
General Impressions of	4.0	4.2	0.378	3.8	3.7	0.672
Financial Influences for	3.3	3.4	0.779	2.6	2.7	0.248
Perception of Engineering contribution to society	4.0	3.8	0.312	3.9	3.9	0.627
Perception of work of engineers	4.0	4.0	0.997	3.7	3.7	0.682
Enjoyment of math & science	3.0	3.8	0.257	2.6	3.0	**0.06**
Accurate understanding of engineering work	3.6	3.8	0.128	3.6	3.5	**0.075**
Family Influences for choice of major	2.6	2.6	0.979	2.0	2.2	0.287
Confidence in Engineering knowledge	2.8	3.6	**0.002**	2.7	3.0	**0.054**
Confidence in communications & computers	3.9	4.0	0.726	3.8	4.0	**0.065**
Adequate study habits	2.5	2.1	0.444	2.6	2.7	0.54
Affinity for Teamwork	2.8	3.1	0.194	2.9	3.0	0.385
Problem-solving ability	3.9	3.6	0.214	3.4	3.6	0.17
Affinity for technical work	3.8	4.1	0.152	3.4	3.5	0.186
enjoy science & math (Q6)	3.0	3.8	0.257	2.6	3.0	0.084
PE requires an MS or PhD (Q9)	3.0	3.1	0.802	2.9	3.0	0.228
Work of Engineers & Scientists is identical (Q15)	2.9	2.3	0.12	2.2	2.4	0.184

Comparison of Post to Pre Survey, Engineering students in Project-Based vs. Non-Project Based Course									
	Project-Based 2003			Project-Based 2004			Non Project-Based		
	Pre	Post		Pre	Post		Pre	Post	
Students in Survey:	22	19		31	24		21	17	
	Mean		Signific.	Mean		Signific.	Mean		Signific.
Attitude	4.4	4.3	0.52	4.2	4.4	0.208	4.1	4.1	0.97
Understand	3.9	3.6	**0.011**	3.9	3.8	0.401	3.9	3.8	0.6
Interest	4.3	4.2	0.395	4.1	4.2	0.608	4.2	4.3	0.22
Confidence	3.6	3.6	0.731	3.4	3.5	0.411	3.4	3.5	0.512

Conclusion

References

1. Collura, M.A., B. Aliane, S. Daniels, and J. Nocito-Gobel, "Development of a Multi-Disciplinary Engineering Foundation Spiral", Proceedings, 2004 American Society for Engineering Education Annual Conference and Exposition, Salt Lake City, Utah, June 20 – 23, June 2004.
2. Nocito-Gobel, J., S. Daniels, M. Collura, and B. Aliane, "Project-Based Introduction to Engineering - a University Core Course", Proceedings, 2004 American Society for Engineering Education Annual Conference and Exposition, Salt Lake City, Utah, June 20 – 23, 2004.
3. Besterfield-Sacre, M.E., C.J. Atman, and L.J. Schuman, "Engineering Student Attitudes Assessment", *Journal of Engineering Education*, 87(2), April 1998, pp. 133-141.
4. Besterfield-Sacre, M.E., N.Y. Amaya, L.J. Schuman., and C.J. Atman, "Implications of Statistical Process Monitoring for ABET 2000 Program Evaluation: An Example Using Freshman Engineering Attitudes", Proceedings, 2003 American Society for Engineering Education Annual Conference and Exposition.

JEAN NOCITO-GOBEL

Jean Nocito-Gobel, an Assistant Professor of Civil & Environmental Engineering at the University of New Haven, received her Ph.D. from the University of Massachusetts, Amherst. She is currently serving as the Coordinator for the First Year Program. Her professional interests include modeling the transport and fate of contaminants in groundwater and surface water systems, as well as engineering education reform.

MICHAEL COLLURA

Dr. Collura, Professor of Chemical Engineering at the University of New Haven, received his B.S. Chemical Engineering from Lafayette College and the M.S. and Ph.D. in Chemical Engineering from Lehigh University. His professional interests include the application of computers to process modeling and control, as well as reform of engineering education.

SAMUEL BOGAN DANIELS

Samuel Bogan Daniels, Assistant Professor of Mechanical Engineering, University of New Haven, received his Ph.D. in Mechanical Engineering from Boston University and has a P.E license in CT. He is currently the freshman advisor for Mechanical Engineering, ASME & SAE Faculty Advisor, PLTW UNH Affiliate Professor, and has interests in solid modeling, electric vehicles and composites.

ISMAIL ORABI

Ismail Orabi is an Associate Professor of Mechanical Engineering at the University of New Haven. He currently teaches the non-project based versions of the Introduction to Engineering course.

This survey is to assess student's opinions and feelings about engineering. Please answer the questions quickly, selecting the responses which most closely match your opinions. Your instructor will not have access to your survey and your response will have no effect on your grade in this class.

Student Number:	Ethnicity:
Major:	O African American
ES107 Section: O 1 O 2 O 3 O 4 O 5 O 6 O 50	O Asian Pacific
Semester: O Fall O Spring **Year:**	O Hispanic
Gender: O Female O Male	O Native American
Age	O White Caucasian
Class Rank O Freshman O Sophomore O Junior O Senior	O Other
Student Status: O Full Time O Part Time	

	Select the response which best reflects your opinion and feelings:	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	I expect engineering is a rewarding career.	**1**	**2**	**3**	**4**	**5**
2	I expect that studying engineering is rewarding.	**1**	**2**	**3**	**4**	**5**
3	The future benefits of studying engineering are worth the effort.	**1**	**2**	**3**	**4**	**5**
4	From what I know, engineering is boring.	**1**	**2**	**3**	**4**	**5**
5	Engineers are innovative.	**1**	**2**	**3**	**4**	**5**
6	I enjoy science and math more than other subjects.	**1**	**2**	**3**	**4**	**5**
7	My parents were very influential in determining my field of study.	**1**	**2**	**3**	**4**	**5**
8	Engineering is an occupation that is well respected by other people.	**1**	**2**	**3**	**4**	**5**
9	A masters or PhD in engineering is needed to become a professional.	**1**	**2**	**3**	**4**	**5**
10	Improving the welfare of society is a primary concern of engineers.	**1**	**2**	**3**	**4**	**5**
11	Financial considerations were a significant factor in my choice of major.	**1**	**2**	**3**	**4**	**5**
12	Starting salaries for engineers are generally higher than most other fields.	**1**	**2**	**3**	**4**	**5**
13	The practice of engineering requires creativity.	**1**	**2**	**3**	**4**	**5**
14	Engineering graduates have no difficulty getting good jobs.	**1**	**2**	**3**	**4**	**5**
15	There is no real difference between work done by engineers and scientists.	**1**	**2**	**3**	**4**	**5**
16	Engineering has contributed greatly to fixing problems in the world.	**1**	**2**	**3**	**4**	**5**
17	On balance, technology has had a positive impact on the world.	**1**	**2**	**3**	**4**	**5**
18	I enjoy figuring out how things work.	**1**	**2**	**3**	**4**	**5**
19	I have a good understanding of what an engineer does.	**1**	**2**	**3**	**4**	**5**
20	Engineering is primarily an individual activity rather than a team effort.	**1**	**2**	**3**	**4**	**5**
21	I prefer to study in a group rather than alone.	**1**	**2**	**3**	**4**	**5**
22	I consider myself to be creative.	**1**	**2**	**3**	**4**	**5**
23	I should spend more time studying than I currently do.	**1**	**2**	**3**	**4**	**5**
24	I am good at problem-solving.	**1**	**2**	**3**	**4**	**5**
25	In the past, I have not enjoyed working in an assigned group.	**1**	**2**	**3**	**4**	**5**
26	I enjoy working with technical things.	**1**	**2**	**3**	**4**	**5**
27	I enjoy open-ended problems.	**1**	**2**	**3**	**4**	**5**
28	I believe that my abilities would allow me to succeed in engineering.	**1**	**2**	**3**	**4**	**5**
	Select the response which best reflects your confidence in your ability or skill in each of the following areas:	**Very Unsure**	**Unsure**	**Neutral**	**Confident**	**Very Confident**
29	Chemistry	**1**	**2**	**3**	**4**	**5**
30	Physics	**1**	**2**	**3**	**4**	**5**
31	Calculus	**1**	**2**	**3**	**4**	**5**
32	Engineering Subjects	**1**	**2**	**3**	**4**	**5**
33	Computer Analysis Skills (e.g., spreadsheet, programming)	**1**	**2**	**3**	**4**	**5**
34	Writing	**1**	**2**	**3**	**4**	**5**
35	Speaking	**1**	**2**	**3**	**4**	**5**
36	Computer Communication Skills (e.g., wordprocessing, presentation)	**1**	**2**	**3**	**4**	**5**