

Educational Research Report

Senior Self-Assessment Survey: Engineering-Related Professional Practice Skills

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During AY 00-01, I investigated the self-assessed ratings with respect to the EC2000 a-k criteria for students enrolled in senior design (XXX 488). I decided to focus on student achievement levels on certain outcomes that I identified as engineering-related professional practice skills. These skills included outcomes d,,f, g, i, and j (teamwork, ethics, communication, lifelong learning, and contemporary issues). This report summarizes some of my observations concerning student achievement of these engineering-related professional-practice skills.

To measure the students' confidence level, I used the results of the Senior Self-Assessment Survey designed and administered by the Assessment Committee chaired by Dr. Marjorie Davis. A summary of data from AY 97-98, 98-99, and 99-00 surveys was distributed to the faculty at the August 2000 retreat; I decided to use the AY 97-98 results as the baseline data. In May 2001, I used AY 00-01 survey results provided to me by the dean's office to measure how our current students' self-assessment compared with the 1998 seniors. A group of 11 seniors completed the survey during their final senior design course at the end of the fall 2000 term; 53 completed the survey form during their final senior design course at the end of the spring term. Due to the large difference in enrollment, I analyzed each term separately. When analyzing the current data, I used the same rating values (1 = low/poor 5 = high/outstanding) that the Assessment Committee used for the past years' surveys. Table 1 shows the average scores from the three surveys (Spring 1998, Fall 2000, and Spring 2001). Table 2 shows the relative rankings of each of the eleven outcomes for the three surveys.

Table 1

Comparison of Senior Survey Results - Weighted Scores

Outcome	Weighted Average ^a		
	May 1998	Dec. 2000	May 2001
a. an ability to apply knowledge of mathematics, science, and engineering	3.83	4.09	4.05
b. an ability to design and conduct experiments, as well as to analyze and interpret data	3.58	4.27	3.95
c. an ability to design a system, component, or process to meet desired needs	3.79	4.27	4.02
d. an ability to function on multi-disciplinary teams	4.26	4.80	4.28
e. an ability to identify, formulate, and solve engineering problems	3.74	4.27	3.90
f. an understanding of professional and ethical responsibility	3.26	4.54	3.93
g. an ability to communicate effectively	4.02	3.90	4.39
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context	3.26	3.20	3.82
i. a recognition of the need for, and an ability to engage in lifelong learning	3.75	4.45	4.34
j. a knowledge of contemporary issues	2.83	4.00	3.61
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	3.43	4.18	3.90

^a 1 = low/poor 5 = high/outstanding

Table 2

Comparison of Senior Survey Results - Outcome Rankings

	Outcome	Relative Rank		
		May 1998	Dec. 2000	May 2001
a.	an ability to apply knowledge of mathematics, science, and engineering	3	8	4
b.	an ability to design and conduct experiments, as well as to analyze and interpret data	7	5	6
c.	an ability to design a system, component, or process to meet desired needs	4	5	5
d.	an ability to function on multi-disciplinary teams	1	1	3
e.	an ability to identify, formulate, and solve engineering problems	6	5	8.5
f.	an understanding of professional and ethical responsibility	9.5	2	7
g.	an ability to communicate effectively	2	10	1
h.	the broad education necessary to understand the impact of engineering solutions in a global and societal context	9.5	11	10
i.	a recognition of the need for, and an ability to engage in lifelong learning	5	3	2
j.	a knowledge of contemporary issues	11	9	11
k.	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	8	7	8.5

In addition to the quantitative data listed above that relates to all eleven outcomes, I conducted a qualitative analysis of responses for each of the seniors who completed the senior survey in May 2001 with respect to certain engineering-related professional practice skills outcomes. Table 3 lists a representative sample of responses to the Outcome F (ethics and professional behavior) question. Table 4 lists a representative sample of responses to the Outcome I (lifelong learning) question. Table 5 lists a representative sample of responses to the Outcome J (contemporary issues) question.

Table 3

May 2001 Senior Survey: Select Responses to Outcome F

Rating	Spec.	Where or From Whom You Obtained This Ability	What evidence could you provide to support your claims?
1	ME	Didn't really have any	-----
2	ECE	EGR 107 & EGR 386	"Order of the Engineer" ring and its meaning.
2	ISE	None	No class available on ethics
4	ECE	This was actually obtained from working in the manufacturing industry.	My work experiences at General Electric (GE), TRANE, and ARINC.
3	BME	Various teachers, like [name of teacher]	Most teachers would always say don't cheat.
4	ME	Life	I think I make pretty ethical decisions.
4	BME	EGR 108; BME 491	108 – our group was assigned an event that involved controversial ethics and had to give a presentation on this event and ethical decisions made. 491 – a homework assignment was to read the NSPE code of ethics and take the quiz on their website.

4	ECE	TCO 341; senior design; EGR Econ.	Junior level and FE exam; ethics sections
4	EVE	Teachers	Throughout all of my classes, the teachers talked about ethical situations I would face in the real world.
5	ECE	Engineering Econ., EGR 107	My behavior on a daily basis
5	BME	Working with others; organization leadership positions	Making decisions that are in the best interest of the organizations and others besides for yourself.
5	BME	EGR 108; PHI 254; BME 288	I understand the power that engineers have, and I understand the responsibility that comes with that power. I have read the ethical code for a professional engineer.
5	ME	In our freshman ethics class	Well, by answering ethics questions on the FE exam correctly

Table 4

May 2001 Senior Survey: Select Responses to Outcome I

Rating	Spec.	Where or From Whom You Obtained This Ability	What evidence could you provide to support your claims?
3	ME	College in general; there are so many interesting topics and subjects that it would take forever to learn	In the environmental field, there are several topics that I would be interested in learning more about. Examples include air quality, land development, marine/ocean engineering.
3	BME	Summer fellowship at [name of school]	I was assigned a project in which I did not have very much experience in and had to do much research in learning the background of the project, what had been done in the past in the field, and how this approach was different and better. In addition, I had to learn the theory behind the project. Every day was a learning experience.
4	ECE	The discipline of electrical engineering	We as electrical engineers must stay informed of current developments or the field will pass us by.
4	ECE	Word of mouth of professors; senior capstone; [name of teacher]'s DSP papers	"Term" papers I have written for various classes over topics related to the course but not covered in the course.
4	ME	Co-op	I saw a need to get my master's degree if I want to enter management.
5	EVE	Work experience obtained during internships	The fact that I am seeking employment with a company that provides monthly training workshops
5	BME	Desire/knowledge that I've had since a very young age; senior design; all BME courses	The evidence for such a goal is not really tangible because it's a desire/will power that I possess. Learning does not end simply because I have a degree.
5	ECE	[name of school]	After graduation, I will be going to graduate school.

5	ECE	[name of school], a will to learn has always been instilled in my head.	Constantly going above and beyond to learn how something works and why
5	ME	In the freshman classes, they really drive the point home.	In the fact that I want to continue my education
5	ISE	Student organizations, such as NSPE and IIE	Attendance at conferences and exposure to workshops

Table 5

May 2001 Senior Survey: Select Responses to Outcome J

Rating	Spec.	Where or From Whom You Obtained This Ability	What evidence could you provide to support your claims?
1	ECE	I have no clue of what is going on right now unless it is mentioned in class or if there is no broadcast with news in the EGR building. I will not be aware of any during my stay at [name of school].	-----
2	ECE	IEEE; NSBE	Publications and community service ventures done and achieved through those organizations
3	ME	The news; CLA classes	I can normally take part in discussions concerning contemporary issues.
3	ISE	ISE 327 [name of teacher]	Periodically, we had to find articles that contained a company that was using a particular principle and also how it was being applied.
3	ECE	SWE; Alumni lectures	Meeting [name of school] graduate engineers
3	ME	As an engineer, you really don't get to see the news that often.	I would learn about things that were happening later after they had happened.
4	EVE	Env. Curriculum	Work on environmental projects that affect large populations with both social and legal impacts. (All env. issues are contemporary issues.)
4	ISE	Student organizations and professors	Ability to effectively communicate on these issues
5	BME	Everywhere	We are exposed to this all the time. By professors bringing in articles, conversations with other students, the internet, TV, and the printed press.

5	EVE	CLA courses; SDC 300; EVE 491 (Env. Law); EVE 407 (AIR pollution); EVE 405/406 (Water/Wastewater Design)	I was required to write 10-page paper on a current social problem and participated in class discussions. In Air Pollution, Water Wastewater & Environmental Law, we discussed current issues as they relate to environmental engineering.
5	BME	BME 288, BME 491	Try to read the New York Times once a week and listen to NPR

Discussion

When evaluating engineering-related professional practice skills, survey results as shown in Table 1 indicate that our students' confidence level for teamwork and communication skills is relatively high. Conversely, students' confidence level for outcome j (a knowledge of contemporary issues) and outcome h (the broad education necessary to understand the impact of engineering solutions in a global and societal context) is relatively low. It is interesting to note that rankings for some outcomes have fluctuated greatly from term to term. Outcomes a, e, f, g, and i have each shown changes of at least three levels some time during the data collection period.

As Koen (1998) recently observed "Engineering schools have consistently provided graduates with technical skills, but provided little, if any, education into the softer skills." (p. 6). Data from the senior survey indicate that our engineering school is producing graduates who may be the exception to the rule. When compared to the 1998 results, ratings for outcomes h and j increased by more than one point for students who completed senior design (XXX 488) in the fall 2000 term. Although outcome i did not show a similar increase, the increase of more than

0.5 point is encouraging. Since I do not have access to the raw data from the 1998 survey, no tests of statistical significance can be conducted on the changes in the students' ratings.

However, a review of the students' qualitative responses (See Tables 3, 4 , 5) may give a clearer picture of the students' confidence in these outcome categories. For example, some of our students see outcome f predominantly in terms of cheating on a test, or behaving well, or knowing that engineers follow a code of ethics. There are indications that students at other engineering schools may have similar views (Haws, 2001). Nevertheless, comments such as the following excerpt from Table 3 imply that some students have captured the essence of ethical and professional behavior. "I understand the power that engineers have, and I understand the responsibility that comes with that power" (BME senior, May 2001). Statements such as this convince me that our hard work is paying off.

For those of you who would like to review the entire set of data, notebooks containing the results of the past four years of senior surveys are available in Dr. Davis' office.

References

Haws, D. R. (2001). Ethics instruction in engineering education: A (mini) meta-analysis. Journal of Engineering Education, 90(2), 223-229.

Koen, P. A. (1998). Using an industry survey to obtain faculty support for ABET 2000 criteria. Proceedings of the Annual ASEE/IEEE Frontiers in Education Conference, Session 2642.