AC 2007-3123: PERCEPTIONS CONCERNING THE INCLUSION OF PUBLIC POLICY MATERIALS IN ENGINEERING CURRICULUM

Douglas Sicker, University of Colorado at Boulder

Tom Lookabaugh, University of Colorado at Boulder

Perceptions Concerning The Inclusion Of Public Policy Materials In Engineering Curriculum

Abstract

In previous research, we surveyed approximately seventy undergraduate and graduate engineering students in order to understand their perspectives on the inclusion of public policy coursework within their curriculum. We sought to determine whether these students thought that it was of value to gain an understanding of public policy as it related to their discipline. We found that many of these students did value such knowledge. We also found that the more senior students and the students with work experience overwhelmingly valued such material.

As a follow-up to this research, we surveyed approximately one hundred engineers in a variety of hiring positions in industry to determine their view on the inclusion of public policy in an engineering curriculum. Among the questions included in the survey, we asked, "Do you believe that engineering students should be exposed to public policy issues as part of their education?" We also addressed a number of other issues, including: 1) How do these engineers define public policy? 2) Should the inclusion of such policy issues be part of a standalone course or integrated into existing courses? 3) Who should teach this material? 4) Could such knowledge help a student advance in their career? and 5) Would you favor hiring students with educational background in public policy? In this paper, we report on the findings of this survey. Of note, we found statistically significant differences based on the engineering discipline and on the job title of the survey participant.

1. Introduction

As part of the Interdisciplinary Telecommunications Program (ITP) curriculum (a master's degree program in the Engineering College at the University of Colorado at Boulder), students have been required to take course work that includes public policy material and attend, as part of an engineering seminar, a year's worth of conferences from the Silicon Flatirons Telecommunications Program; these conferences have strong legal content and emphasis and are hosted by the university's law school. Recent examples include "The Digital Broadband Migration: Rewriting the Telecom Act," "Open Source, Open Standards, and the Future of the Internet," "The End of Politics as We Knew It: Examining the Internet and its Impact on Political Participation," and "Searching for the Third Broadband Pipe." A typical conference consists of 3 to 4 one-hour panel sessions discussing different aspects of the conference's topics. Panels are usually comprised of a mix of lawyers, legal scholars, business executives, technologists and government officials. The conferences are highly regarded by lawyers and legal academics alike. In addition to these conferences, the students are required to take 6 credits of course work that includes a public policy focus (as it relates to telecommunications).

We became interested in understanding whether the inclusion of this course content was of interest and/or value to the students. We could see that the direct exposure of students to legal students, faculty and professionals was highly appropriate in adding public policy sophistication. However, it also engenders substantial angst and grumbling, particularly among engineering students. In fact, each term we receive some number of complaints about the inclusion of policy material in the curriculum (this is a little ironic in that the program expressly advertises itself as an interdisciplinary program). To build an understanding of how students react to public policy coursework and conferences, we embarked on a combination of qualitative (interview based) and quantitative (survey based) research. We first surveyed seven students then administered an anonymous online survey with 67 responses. We sought to determine whether these students thought that it was of value to gain an understanding of public policy as it related to their discipline. We found that many of these students did value such knowledge. We found that students actually have a generally positive attitude about it and that the more senior students and the students with work experience overwhelmingly valued such material. The details of this work are described in section 2 of this paper.

In extending this previous research, we surveyed approximately one hundred engineers in a variety of hiring positions in industry to determine their view on the inclusion of public policy in an engineering curriculum. Among the questions included in the survey, we asked, "Do you believe that engineering students should be exposed to public policy issues as part of their education?" We also addressed a number of other issues, including: 1) How do these engineers define public policy? 2) Should the inclusion of such policy issues be part of a standalone course or integrated into existing courses? 3) Who should teach this material? 4) Could such knowledge help a student advance in their career? and 5) Would you favor hiring students with educational background in public policy?

In this paper, we report on the findings of this recent survey. Of note, we found statistically significant differences based on the engineering discipline and on the job title of the survey participant. In the following section we begin by reviewing the previous student surveys. In section 3, we describe the approach taken in the follow-up survey. In section 4, we present our findings and discuss what they might suggest. We then conclude the paper in section 5 with recommendations.

1. Research on Student Perceptions

Before describing our recent work, we will briefly review our approach and findings of the previous student interviews and surveys. Most of the section is taken directly from our previous paper, “Engineering Students and Law Conferences”, which was published in last year’s ASEE. [7]

1.1. Qualitative Research – Semi-Structured Interviews

To understand engineering student responses and attitudes towards policy curriculum, we used a combination of qualitative and quantitative research techniques in a practice often called triangulation. [3,4] The first phase of our research used semi-structured interviews in a

simplified version of Grounded Theory based qualitative research. [5] Semi-structured interviews consist of a pre-determined set of questions that are asked of each interviewee, but allow the conversation to diverge from answering the questions depending on the responses of the interviewee and conversation between interviewee and interviewers. We used the set of questions given in Table 1 consistently with each of our seven ITP student interviewees selected from volunteers who had attended SFTP conferences in the previous semester. Both of the authors were present in all interviews and interviews were clearly not anonymous. The lack of anonymity could lead to some bias in responses (the interviewers are faculty and therefore involved in certain circumstances in evaluating the interviewees) but we hoped to remove this source of bias in the subsequent, anonymous survey stage.

1. Do you believe that learning about public policy as it relates to your discipline will be valuable to your career as an engineer?
2. How many SFTP conferences have you attended and when? How did you attend them (in person or through distance education)?
3. What is your background (education, professional)?
4. What did you expect to get out of the conference(s)? Were your expectations met?
5. Was the conference an efficient use of your time? Would there be any way to make it more efficient?
6. How relevant was the conference to your education at CU and to your anticipated career? How well did the conferences tie into your coursework?
7. Is the conference format effective? What might make it more effective?
8. What new concepts or information of importance have you learned from conferences? What has left you more confused?
9. How effective were any social networking opportunities for you?
10. Were the conferences enjoyable? Why or why not?

Table 1. Semi-structured Interview Questions.

We recorded each interview with permission of the interviewee, and then subsequently transcribed them. We then applied the "coding" concept of Grounded Theory to identify key concepts in each element of interviewee response and to subsequently group and categorize concepts, looking for similarities and contrasts. The resulting categorization and supporting or elaborating paraphrased interview fragments were then analyzed; the major points summarized. We used the results of the semi-structured interviews to frame questions to ask in the form of a survey instrument with the goals of both improving the size of the population sample and using anonymity to reduce potential bias in responses.

1.1. Quantitative Research - Survey

The results of our interviews served to inform the structure and content of a survey we subsequently developed. The interviews highlighted a number of issues regarding the effectiveness and enjoyment of the policy coverage. They also served to pinpoint some concerns

or dissatisfactions of the students. Overwhelmingly, the interviews suggested that the students found these events to be enjoyable (contrary to perceptions that we might attribute to the 'squeaky wheel' effect of some outspokenly critical students.) The students also found the events to provide an effective way of gaining exposure to public policy issues. However, the students did indicate some dissatisfaction with (1) the writing requirements, (2) the forced attendance, (3) the poor video and audio quality (for distance students) and (4) the limited opportunity to engage the speakers following the event. Based on the above findings, we implemented an online survey; the contents of which can be found in Appendix B of [7] along with summarized results.

Using the Zoomerang survey tool [6], 67 respondents were surveyed concerning their opinions of the SFTP events. These respondents were all present or former ITP students and composed a wide variety of technical and non-technical backgrounds. Nearly 80% of these individuals have technical backgrounds (meaning undergraduate degrees in engineering, science or mathematics) and 70% have two or more years professional work experience. ITP has a strong international student body and the survey reflects this with 36% of the respondents being from abroad. Finally, the majority of those surveyed attended the SFTP events in the last 18 months.

In the student interviews, we found a number of interesting issues regarding the students' perceptions of including public policy in engineering programs.

In assessing aspects of what the students liked, the survey indicated the following:

- Students overwhelming found public policy conferences to be enjoyable.
- Students very strongly believed that the policy conferences help explain current or predict the future state of the industry.
- Students believe that it provides an efficient way to learn policy.

In assessing aspects of the policy conferences that the students disliked, the survey indicated the following:

- Students found that there was not sufficient preparation or review of policy issues in other classes.
- More than half of the students felt that the material wasn't relevant to the rest of the curriculum.
- Students strongly believe that there should be more international policy coverage.

A number of cross tabulations provided interesting insights into the opinions of our students. First, students with technical degrees were less likely to find policy conferences as an efficient way to learn policy. They were also less likely to enjoy the events than those without technical degrees. However, in neither of these cases was the difference between those with technical and non-technical degrees substantial. Second, students with either no work experience or more than 5 years of work experience were more likely to enjoy the events and find them an efficient way to learn.

1. Research on Hiring Engineers Perceptions

To understand hiring engineers' attitudes towards policy curriculum, we again used a combination of qualitative and quantitative research techniques in a practice often called

triangulation. [3,4] As with the previous student surveys, the first phase of this research used semi-structured interviews in a simplified version of Grounded Theory based qualitative research. [5] We used the set of questions given in Table 2 consistently with each of our 12 interviewees selected from local companies. One of the authors was present in all interviews and interviews were clearly not anonymous. The lack of anonymity could lead to some bias in responses, but again we hoped to remove this source of bias in the subsequent, anonymous survey stage.

1. How would you define the phrase "public policy" as it relates to your field of engineering?

   (Here we offered a number of definitions for the individual to consider)[1]

1. Do you believe that engineering students should be exposed to public policy issues as part of their education?
1. If so, what aspects of public policy do you think would be useful for the student to understand?
1. How should the material be covered?
1. Would such knowledge impact a student's future career?

Table 2. Semi-structured Interview Questions.

We recorded each interview with permission of the interviewee, and then subsequently transcribed them. We then applied the "coding" concept of Grounded Theory (as described above) to identify key concepts in each element of interviewee response and to subsequently group and categorize concepts, looking for similarities and contrasts. The resulting categorization and supporting or elaborating paraphrased interview fragments were then analyzed; the major points summarized.

We used the results of the semi-structured interviews to frame questions to ask in the form of a survey instrument with the goals of both improving the size of the population sample and using anonymity to reduce potential bias in responses.

[1] 1. "A set of interrelated decisions taken by a political actor or group of actors concerning the selection of goals and the means of achieving them within a specified situation where those decisions should, in principle, be within the power of those actors to achieve."

2. "A course of action or inaction chosen by public authorities to address a problem."

3. "A system of laws, regulatory measures, courses of action, and funding priorities concerning a given topic promulgated by a governmental entity or its representatives."

4. Your own definition.

1.1. Quantitative Research - Survey

The results of our interviews served to inform the structure and content of a survey we subsequently developed. The interviews highlighted a number of issues regarding the inclusion of public policy in an engineering curriculum. Respondents were surveyed on the following questions based on a 7 point Likert scale.

1. Do you agree with the following definition of "public policy" as it relates to your field of engineering? "Public policy is a system of laws, regulatory measures, courses of action, and funding priorities concerning a given topic promulgated by a governmental entity or its representatives"
1. Do you believe that engineering students should be exposed to public policy issues as part of their education?
1. Do you believe that the inclusion of such policy issues should be integrated into existing engineering courses (as opposed to part of a standalone course)?
1. Do you believe that policy issues should be taught by professors from public policy departments (as opposed to engineering professors)?
1. Would such knowledge of public policy eventually help a student advance in their career?
1. Would you favor hiring students with educational background in public policy?

We were able to gather a broad range of information concerning the demographics of the survey population. The respondents were from a variety of engineering backgrounds. The distribution of engineering disciplines included in the survey was 40 CS/EE, 20 aerospace engineering, 15 chemical engineering and 25 civil engineering. We were also able to gather information about job title. All of the interviewees indicated that they are presently (or have been) in hiring positions; twenty five percent represented themselves' as middle management and twenty percent as upper management. Based on our knowledge of the companies contacted, the demographics information appears accurate.

It should be noted that, by initial design, the two studies do not overlap entirely. The student survey focused on students from computer science and electrical engineering disciplines, whereas the second study included individuals from a broader base of engineering (and included individuals from aerospace, civil and chemical engineering). As previously noted, the distribution of engineering disciplines included in the survey was 40 CS/EE, 20 aerospace engineering, 15 chemical engineering and 25 civil engineering.

1. Findings

A table containing the results of the survey can be found in the appendix; in this section we provide a high level discussion of the findings.

The respondents strongly agreed with the definition of public policy that was provided as a reference. The main finding from this survey was the difference of opinions among the engineering disciplines. We found statistically significant differences based on the engineering discipline and on the job title of the survey participant. Computer science / electrical engineering and civil engineering disciplines have a much stronger perception that including public policy within student training is of value. Seventy five percent of the individuals from a CS/EE background and seventy percent of the individuals from civil engineering thought that such exposure was positive for students. Whereas only twenty five percent of aerospace and thirty three percent of chemical engineers thought that such exposure was positive for students.

In cross tabulation, we found that the individuals who favored the inclusion of public policy also strongly believed that such exposure 1) could help a student advance in their career and 2) would have a favorable influence on their hiring decisions. Not surprisingly, the individuals who did not favor such inclusion believed that such exposure 1) would not help a student advance in their career and 2) would not have a favorable influence on their hiring decisions.

It is possible that these differences among the disciplines are a reflection of how policy and regulation affects the specific discipline. Some disciplines like telecommunications and environmental engineering (here a subset of civil engineering) have federal and state agencies that directly influence business on a daily basis. Many of the individuals who were against the inclusion of such material indicated that there is no room in the curriculum for additional material and that it would only dilute the coverage of technical material. Lastly, these differences could also be a bias introduced by the small sample size.

Among those that thought that public policy should be included in the engineering curriculum, there was a strong belief that the material should be integrated into existing courses. In terms of integrating the material, this creates a number of questions concerning the issue of fitting the material into already overstuffed course syllabi, as well as the issue of sequencing of the material. The survey also demonstrated a strong belief that engineering professors should cover the material.[2] In the interviews it was noted that professors from outside of engineering (such as from public policy programs) might fail to provide the proper connection of the policy issue to the technology.

The final cross-tabulation that we considered was that of job title and perceived value of including public policy in engineering curriculum. Across all disciplines, we found that more senior individuals held a higher value of including public policy in the engineering curriculum. While we did not explore this issue in any detail, we do believe that it might be explained by the fact that more senior individuals tend to deal with the impact of policy and regulatory decisions on a more regular occasion than individuals at lower positions within a company. Also, engineers at lower positions in a company are tasked with more specific technical problems and therefore may not perceive a need for such broader educational background.

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[2] The cross-tabulation of these two issues (i.e., integration content and having engineering professors covering the material) was nearly ninety percent.

2. Recommendations and Conclusion

Based on the interviews, it appears that the CS/EE and civil engineering disciplines have a much stronger perception that including public policy within student training is of value. The survey also suggests that the material should be integrated throughout the curriculum and taught by engineering professors.

As with the earlier student survey, we believe that a larger survey is warranted before strong conclusions can be drawn from this work. We therefore have only one recommendation - that an organization, such as ASEE, conduct a larger survey to explore these topics on a broader scale and in more depth.

3. Bibliography

[1] See http://itp.colorado.edu

[2] See http://www.silicon-flatirons.org

[3] Fielding, Nigel G. and Fielding, Jane L., *Linking Data*, Beverly, Hills, CA: Sage Publications, 1986.

[4] Denzin, Norman K., *The Research Act: A Theoretical Introduction to Sociological Methods*. Prentice-Hall, 1988.

[5] Corbin, Juliet M. and Strauss, Anselm, *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*, 2nd ed., Thousand Oaks, CA: Sage Publications, 1998.

[6] See http://www.zoomerang.com

[7] Douglas C. Sicker and Tom Lookabaugh, "Engineering Students and Law Conferences", the 2006 Annual Conference of the American Society of Engineering Education, 2006.

4. Appendix

On a 7-point Likert Scale (where 1 = Agree Strongly and 7 = Disagree Strongly)

Weighted and rounded average of responses in parentheses.

(Note that these numbers represent the responses of all of the engineering disciplines combined. The results actually created a bimodal distribution for questions 2, 5 and 6, with CS/EE and civil engineering gathered at one mode, and aerospace and chemical engineering at another.)

1. Do you agree with the following definition of "public policy" as it relates to your field of engineering? "Public policy is a system of laws, regulatory measures, courses of action, and funding priorities concerning a given topic promulgated by a governmental entity or its representatives" (1.8)

2. Do you believe that engineering students should be exposed to public policy issues as part of their education? (3.0)

3. Do you believe that the inclusion of such policy issues should be integrated into existing engineering courses (as opposed to part of a standalone course)? (3.4)

4. Do you believe that policy issues should be taught by professors from public policy departments (as opposed to engineering professors)? (5.0)

5. Would such knowledge of public policy eventually help a student advance in their career? (3.6)

6. Would you favor hiring students with educational background in public policy? (3.4)