AC 2010-924: TEACHING ENGINEERING AND TECHNOLOGY PUBLIC POLICY WHILE FULFILLING MULTIPLE ABET AND UNIVERSITY REQUIREMENTS

Todd Myers, Ohio University

Ben Stuart, Ohio University-Athens

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Abstract

Public policy often lags behind innovation and laws are generally created in reaction to social issues. Elected officials are asked to set public policy for technology, the implications of which are typically outside or beyond their individual training and expertise. Conversely, engineers and technologists may not fully appreciate the need for public policy to guide the optimal advancement of appropriate technologies or to regulate specific technologies' potential negative impact upon society. This disparity creates a gap between innovation and regulation not often addressed in current engineering and technology curriculum.

Engineering and technology colleges are beginning to recognize a need to fill this gap by providing public policy background to their undergraduate engineering and technology students in the form of a planned curriculum. In this paper we will review a recent effort to introduce a public policy course into the curriculum at a midsized Midwest university's college of Engineering and Technology. Specifically, we will address how this course came to be, how it was accepted by the faculty and students and how it was used to satisfy ABET accreditation and university requirements.

Introduction

Technology continues to advance in society at an ever increasing rate and becomes more pervasive in our lives year to year. As this occurs "our elected representatives understand less and less about it" [1]. Engineers and technologists are responsible for many of the technological innovations but are often distanced from the regulatory process that constricts sometimes inappropriately a technology or in some cases does not restrict the technology enough.

Engineers and technologists are not typically cross-trained in the social sciences and social scientists are not trained to think about technologies particularly new, emerging, and converging technologies.[2] Engineers and technologists need to learn how to participate in the legislative and policy-making process that will frame developing and existing technologies.[3]

If engineers and technologist were to develop an understanding of the mechanics of public policy they may be able to assist in the shaping of public policy that influences technology innovations.[4] "Opportunity to provide public policy background to engineers and technologists is during their undergraduate experience in the form of a planned curriculum in Engineering and Technology Public Policy (ENTPP)".[5]

One concern is how would such ENTPP courses fit in to an already full engineering and technology curriculum. One answer is that ENTPP courses can help satisfy Accreditation Board for Engineering and Technology (ABET) program outcomes h "The broad education necessary to understand the impact of engineering solutions in a global and societal context" and j " A

knowledge of contemporary issues", and f "An understanding of professional and ethical responsibility".[5] Another way is to design a course in such a way that it may be used to meet a university requirement such junior English which would allow the course to be taken as an alternative to an existing English course.

Course design

Upon establishing a need for an ENTPP curriculum the question of what arises as to what learning outcomes should be include in to such a class, what instructional design method should be used to create the curriculum, how to gain buy in from the programs within the college for such a curriculum.

The support came for this ENTPP course from the top down. The Dean of the Russ College of Engineering and Technology (where this class was developed and taught) provided great support and wanted the first course to be a college level course vs. a program level course. The dean authorized the author to organize a cross departmental steering committee to assist in the design of the first prototype ENTPP course for the college. Individuals were identified to participate on the committee based on their personal experience with previous work with legislators at the state and federal level.

Learning outcomes for a ENTPP curriculum were identified in the study "Learning Outcomes For An Engineering And Technology Public Policy Curriculum" conducted in 2007.[5] In the study 45 ENTPP learning outcomes were identified. These learning outcomes were reviewed and ranked by the group. From the list 18 learning outcomes were identified for inclusion in this first ENTPP course. These learning outcomes can be seen in the course syllabus included in appendix A.

After a review for relevant instructional design models "The Instructional Design Process" by Jerrold E. Kemp, 1985 was chosen. The Kemp model of instructional design is based on ten elements/activities: 1) Learning needs, Goals, Priorities/Constraints, 2) Topics-Job Tasks Purpose, 3) Learner Characteristics, 4) Subject Content Task Analysis 5) Learning Objectives, 6) Teaching/Learning Activities, 7) Instructional Resources, 8) Support Services, 9) Learning Evaluation, and 10) Pre-testing.[6]

The Kemp model was followed but it may be of particular interest to the readers the steps which took the most thought and time during the course development were deciding how organize the class week by week, with which learning outcomes to target, which order to present the learning outcomes, and the text book and reading material selection. The topic order was agreed upon by committee. The text book selection was a lengthy process attempting to make sure all topics under review in the course (books list and reading list can be seen in appendix A).

As the course design moved forward and deliverables were designed it became evident that the course under design was writing intense course. At the university this course is designed for a writing intense course can be reviewed by a university committee for approval to satisfy a university wide junior English writing course requirement. The course was submitted for review by the university committee and it was determined by that committee that the course would be

granted a junior English designation satisfying the university junior English requirement. The junior English designation also met that all engineering and technology students could satisfy a mandatory class requirement by taking this new ENTPP course thus providing some incentive to the students to take the new course.

The primary course designer did not teach the fist offering of this ENTPP course. A professor in the Russ College was identified by the Dean to offer this first course. This professor had experience dealing with legislators and had received teaching excellence awards by the college. Working together the designer and the professor launched the first ENTPP course offering Spring of 2009.

Course delivery

While enrollment for Tier I courses (Junior Composition, a.k.a. "J-courses") are not capped by University requirements, most faculty teaching J-courses restrict enrollments to 20 students. This is done primarily due to the heavy writing component and the need for faculty feedback on students' writing skills. Significant out-of-class time is devoted to each student in the development of critical written communication skills. Further, while engineering students often have developed sufficient technical writing skills by the Spring quarter of their Junior year, policy writing to targeted audiences is substantially different that writing laboratory or design project reports.

For this first class offering it is of interest to note that the class enrollment was 25 students, with several additional students requesting entrance that could not be accommodated. Most students responded that they were intrigued by the course topic and felt an understanding of, and ability to contribute to, policy writing was a valuable tool for their respective careers.

As per University calendar, the class met on Monday and Thursday evenings for two hours. With a ten-week quarter system and one observed holiday, this provided 19 class sessions. Slight modifications to the course content and outcomes were made based on evaluation of the student's level of response and degree of questioning during the first several class meetings. It was decided that covering fewer outcomes at a pace that offered greater probability of mastery was preferred to rushing through material for the sake of sticking to the developed syllabus. Based on the published syllabus (see Appendix), course outcomes that were diminished in coverage included outcomes 2, 5, 9, 16, and 17 and a few that were eliminated as explicit topics (although some representative ideals were included in discussion of other topics) included outcomes 8, 10, and 14.

The first two classes were devoted to writing basics, including assignments on punctuation, format, citation, and style (e.g. APA vs. MLA). The next four classes focused on the Federal government structure and processes (e.g. how laws are made and enacted) and an additional two classes were spent on State government operations. The following two classes were focused on introductory topics for writing public policy (text by C.F. Smith), while three classes were devoted to policy analysis and policy writing (i.e. identifying audience, selection and evaluation of alternatives, presentation of ideas – text by C.V. Patton and D.S. Sawicki). Two additional classes were spent looking at decision making and public policy for engineers and technologists with a focus on how economics, risk, and environmental issues play a role

(text by P.W. Hamlett), while one class period was spent on ethics and how to perform environmental risk assessments.

The final three class periods were devoted to presentations by content experts in fields of interest to engineers and technologists, followed by open forum discussions where students engaged the experts on issues of policy decision making. The first guest was Andrew Revkin, a prize-winning reporter for the New York Times and author mainly covering environmental issues in their social and political context. His blog, Dot Earth, engages the public in a discussion of strategies for balancing human activity with the planet's limited resources and he has written books on the Amazon, Arctic, and global warming. Other guest speakers were fellow faculty in the Russ College of Engineering and Technology. Dr. Greg Kremer presented issues related to the auto manufacturing industry with a focus on environmental and fuel performance. Drs. Dave Bayless and Kevin Crist presented information on carbon dioxide and energy issues and related these to the current pieces of legislation working their way through the Federal government.

Observations

Student performance was measured based on evaluation of 19 separate assignments weighted in three categories. Eleven minor (less than one page) assignments were averaged to account for 20% of the final grade. These assignments included punctuation practice, citation and reference formatting, an in-class response to a journal article, the first research topic paragraph and letter drafts, and participation in the discussions with invited guest speakers. Five assignments were considered more developed in scope and effort and were averaged to account for 30% of the final grade. These included responses to text and outside reading assignments (2-3 pages minimum), as well as the second draft of the letter to a government representative. The final draft of the research paper, the final paper and the letter to the government representative were considered the major deliverables for the course and as such were averaged and accounted for 50% of the final grade. The final paper rubric is attached in appendix A for the readers review.

An assessment of student knowledge of the stated outcomes was performed on the first and last days of the course. As expected, student responses on the entrance assessment identified several shortcomings in their ability to communicate policy issues at a level anywhere above the most basic understanding. When asked to identify if the student was able to respond to the outcome, on a class average, entering students answered "No" more than 50% of the time. The exit assessment suggested that the majority of the students significantly increased their understanding, and ability to communicate factors that drive policy issues. None of the individual students assessed answered "No" to more than 45% of the questions (n = 4), while 13 students were able to provide appropriate answers to more than 75% of the 18 outcomes. If the fact that significant material was not covered on the outcomes listed previously due to course time constraints is accounted for, on average students were able to provide appropriate answers to more than 80% of assessed outcomes.

Conclusions

Student demand for subsequent offerings of the Engineering and Technology Public Policy class have already required a slight change in the anticipated delivery for the Spring 2010 quarter. While all students will participate in a combined lecture where course material will be delivered and guest experts will lead interactive discussions, additional recitation sections could be held to allow for discussion participation by all students as well as an opportunity to assign additional faculty to serve as writing mentors. This system would allow the increased projected enrollments based on anticipated demand and increased time on reviewing and evaluating writing skills which will significantly increase the value of the class to the student, while simultaneously decreasing the workload on a single faculty member. Further, some of the lectures and reading materials related to operation of Federal and State governments were identified by the students as redundant, and should subsequently be reduced in scope and content. This would allow for additional guest lectures by content experts in additional fields of engineering and technology policy issues, as well as the coverage of some of the topics identified in the original syllabus that were excluded due to time constraints from the first offering of the course.

Bibliography

1   Davis, L., Gibbin, R. (2002). National academy of engineering. In L. Davis, & R.
                Gibbin (Eds.), Raising public awareness of engineering (pp. 18-46).
                Washington, DC: The National Academies Press.

2   Johnson, D. (2004). *Computer Ethics*. Upper Saddle River, NJ: Prentice-Hall.

3   King, C. (2006). *Engineers should have a college education* (Report No.
                CSHE.8.06). Berkeley CA: Studies in Higher Education. (ERIC Document
                Reproduction Service No. ED 492162)

4   Herkert, J. R. (2004). *Microethics, macroethics, and professional engineering
         societies*. Emerging technologies and ethical issues in engineering:
         Papers from a workshop (pp. 107-113). Washington, DC: The National
         Academies Press.

5   Myers, T. (2007). "*Learning Outcomes For An Engineering And Technology Public Policy Curriculum*"
         Published Dissertation 181 pages on-line June 07.
         Diss. Ohio University , 2007. Ann Arbor: ProQuest/UMI.

6   Kemp, J. (1985). *The Instructional design process*. NY: Harper & Row
         Publishers.

Appendix A

ET-385J - Engineering and Technology Public Policy
SPRING 2009 Syllabus – Call No. _____

Class Days: M, Th   Time: 5:10 – 7:00 p.m.
Room:_____   Building: _____
Professor: _____   Office Hours: _____
Office: _____   E-mail: _____Phone:

Course Description and Objectives

In this writing course, undergraduate engineering and technology students will learn about the legislative, regulatory, and policy-making processes that will frame developing and existing technologies. Course content includes the theory, structure, and function of government as relates to engineering and technology public policy at the state and federal level. The course also includes a writing intensive, project-based learning component in which the student will have the opportunity to evaluate energy, bio-medical, or other engineering and technology public policy from the standpoint of usage, regulation, environmental and societal impact of the technology, economic analysis, the public perception of the technology, and the predictions for the technology over the next twenty five years.

This course will assist in satisfying ABET engineering accreditation standards f) understanding of professional and ethical responsibility, g) ability to communicate effectively, h) The broad education necessary to understand the impact of engineering solutions in a global and societal context, and j) A knowledge of contemporary issues.

The specific outcomes of this course are:

1) Become aware of the power struggle that exists amongst the players in any specific public policy.

2) Become aware of the international factors that influence policy-making.

3) To be able to write a letter to your public officials.

4) To understand how public policy emerges in from government.

5) To find examples of metropolitan regulatory agencies as they relate to your discipline.

6) To cite about examples of how interest groups affect policy formation.

7) To understand how to access your political representatives and gain their support.

8) To become familiar with the laws that regulate how individuals can try to influence public officials.

9) To become familiar with how interest groups are formed.

10) To become familiar with the laws that regulates interest groups.

11) To be able to provide examples of whom legislators rely upon for guidance in technical policy issues.

12) To become familiar with the factors a politician uses to decide whether to support an agenda/policy.

13) To find possible ways that you may be able to influence your political representatives.

14) To find ways that implementation of a law varies due to interpretation of language in a law.

15) To become familiar with how Congress oversees policy implementation.

16) To become familiar with administrative law and how it can impact/challenge engineering and technology regulation.

17) To become familiar with a few of the basic ethical frameworks for such as utilitarian and deontological approaches and how these ethical frameworks influence public policy.

18) To become familiar with the separation of powers (i.e. legislative, executive, judicial) in state government and their respective impacts on public policy.

In order to achieve these outcomes you will read, listen to lectures, think about, write about and discuss contemporary public policy, ethical theory as it relates to engineering and technology. This course requires *extensive* reading, frequent writing, and expansive thinking.

Textbook and Current Events REQUIRED!

- "Understanding Technological Politics: A Decision Making Approach", by Patrick Hamlett
- "Writing Public Policy", by Catherine F. Smith
- "Basic Methods of Policy Analysis and Planning", by Carl Patton and David Sawicki
- "The Elements of Style", Fourth Edition by William Strunk Jr. & E. B. White

Web Link Reading:

- "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change", by Searchinger, Heimlich, Houghton, Dong, Elobeid, Fabiosa, Tokgoz, Hayes, Yu. At http://www.sciencemag.org/cgi/content/abstract/1151861
- How are laws are made by Johnson, and Ney at http://thomas.loc.gov/home/lawsmade.toc.html
- *From time to time you will be asked to read other articles from free online sources*

Tentative Schedule:

Week	Class	Topic	Reading	Deliverables
1	1	Entrance Assessment and Course Introduction	The Elements of Style	
1	2	Writing Process & Expectations for Written Work Format, citation, style: APA, MLA in-class practice http://www.unk.edu/acad/library/gov_doc/about/index.php?id=14245 http://www.unk.edu/acad/library/gov_doc/		

		about/index.php?id=8936		
2	1	Introduction to theory, structure and function of government as it relates to public policy. http://thomas.loc.gov/home/lawsmade.toc.html **Reading Responses 1 & 2 (RR 1 & RR 2)**	The House: How are Laws are Made Down load pdf at this web site and read.	
2	2	Federal Level: Three brances of government http://thomas.loc.gov/home/enactment/enactlawtoc.html **RR 3**	Down Load and read PDF at this web site.	Summary of How Laws are Made sections I-VIII (RR 1)
3	1	Introduction to federal level theory, structure and function of government as it relates to technology, energy and biomedical public policy.		Summary of How Laws are Made sections IX-End (RR 2)
3	2	**Quiz 1** Federal Three Branches of Government, How Laws are Made & Enactment of laws. State level Branches of Government http://www.lsc.state.oh.us/guidebook/	Down Load and read Pages ( ) from "A Guidebook for Ohio Legislators"	How Laws are Enacted (RR 3)
4	1	Introduction to State level theory, structure and function of government as it relates to technology, energy and biomedical public policy.		
4	2	**Quiz 2** State Level Branches of Government Read Pages 1-75 in "Writing Public Policy" FRAMING THE PROBLEM Current Engineering and Technology Public Policy (in class discussion) Hand out: Framing the Problem Assignment	See topic	Bring to class at least 2 articles you have read recently about an Engineering and Technology Public Policy issue.
5	1	Know the Record and Know the Arguments Read Pages 76-110 in our class book "Writing Public Policy Petitions and Proposals & Opinion Statements Read Pages 111-140 in our class book "Writing Public Policy	See topic	Framing the problem paper. Pick a topic that is important to you!
5	2	Writing Public Comment		

		Implementation of an Engineering or Technology public policy and its Economic and Environmental Impacts		
6	1	Mid-Term		
6	1 & 2	Engineering and Technology Ethical Issues		
7	1 & 2	Evaluation of a Current Energy Policy Review		
8	1 & 2	Evaluation of a Current Bio-Medical Policy Review		
9	1	Engineering or a Technology public policy and the Public Perception		
9	2	Grassroots level policy movements, professional associations and lobbying		
10	1&2	Final Project Presentation		

Reading Response Papers *(3) – Short essays (minimum 2 pages double-spaced). May include readings from textbook or from outside sources.*

Framing the Problem Papers *(1) – Short essay (minimum 2 pages – Max 4 pages double-spaced) about an Engineering and Public Policy issue that you have been approved to write about. May include readings from textbook or from outside sources.*

Positional Papers *(2) – Short arguments (minimum 3 pages double-spaced) For Positional Paper 1, identify a situation, determine applicable decision-making framework(s), and argue one position for or against. For the second Positional Paper, write from an opposing viewpoint or perspective.*

Quizzes and Final

In-Class Activities – TBD *Occasionally, short writing or speaking activities may be assigned during class to be completed during class (e.g. debate or short opinion paper). A small number of points, usually 3-5, may be assigned. If you miss class and do not have a university recognized excuse, you may not make up the points for missed in-class activities.*

Participation - E**arn** up to 5 points for exceptional participation – penalty of up to 5 points for poor participation. *To earn credit for participation, you must not only be physically present in class, but also demonstrate intellectual engagement with the materials through meaningful and material participation in class discussions, debates, and other in-class activities. Be prepared for value-added participation by reading the assigned material, developing notes, and speaking thoughtfully and candidly about the assigned reading. Be prepared to identify, compare, and contrast opposing perspectives.*

Grading Scale:

			A	=	93-100%	A-	=	90-92.9%
			Exemplary					
B+	=	87-89.9%	B	=	83-86.9%	B-	=	80-82.9%	Good
C+	=	77-79.9%	C	=	73-76.9%	C-	=	70-72.9%
		Satisfactory						
D+	=	67-69.9%	D	=	63-66.9%	D-	=	60-62.9%	Poor
F	=	59.9% and below						Failing

Course Policies

Attendance: ET-385j is designed to be an interactive course. You will be involved in each session by writing and/or speaking, not just taking notes while your professor lectures. Attendance will be take attendance during each class period. If you miss class without an excused absence, you may not turn in late assignments and you may not make-up any in-class activities.

While you are in the classroom, please do not engage in distracting behavior such as texting, reading the newspaper or non-course related materials, etc. or you may be asked to leave and lose out on participation/attendance points.

Due Dates: All out-of-class writing assignments are due at the beginning of the class session. No late assignments will be accepted and a zero grade will be given to assignment not collected at the being of the class. This includes "forgotten" assignments, printer issues, etc. Out of class writing assignments may be turned in at the time of the next class period IF the absence is a recognized as an excused absence according to _____ official policy (Please see Student Handbook, available online at ███████████████████████████████████████) but only if the professor is <u>notified beforehand</u>. In the case of absence due to emergency, the student shall inform the professor in person or by email within 24 hours.

Holiday Observance: Every reasonable effort will be made to respect cultural, ethnic, or religious holiday observances. If your personal observance of a holiday conflicts with class attendance, notify the instructor at least one week in advance so that alternative arrangements can be made.

Academic Misconduct: The ███ University Code of Student Conduct (outlined in the undergraduate catalog) prohibits any form of academic dishonesty, cheating, or plagiarism. Such misconduct will result in a failing grade for this class and referral to ███ University Judiciaries.

Blackboard (Bb) Course: This course utilizes the ███ University Blackboard (Bb) for accessing course materials, posting student grades, and submitting selected deliverables. You are responsible for checking the database daily for announcements. I may occasionally email information about assignments or the class schedule. I will email to your ███ account only; you are responsible for messages you forward to another account.

Turnitin.com: You may be required to submit designated assignments to turnitin.com. Please register with this website on the first day of class. To do so, at the welcome page, click on *"Create a new user profile,"* then follow the step-by-step instructions. Turnitin.com compares your work to Internet content and content uploaded to Turnitin's database and provides a report of any suspected plagiarism. *Assignments with a turnitin.com designation will not be*

considered "turned in" if not posted to turnitin.com by 11:59 p.m. on the due date and will receive a zero.

Questions about Graded Assignments: Students with questions about a graded assignment should contact me in person or by email within a week after the assignment grade is posted. Assignments will not be reevaluated after that time. Out of respect for your privacy, I will not discuss individual grade issues at any time in the classroom.

Final Project

Final Paper due date: Wednesday, June 10, 2009 at 7:00 p.m.

Part 1: Research paper

1. Approximately 10 double-spaced pages at 12 point font and 1 inch margins.
2. Written as a technical document (except for last section).
3. Sections include:
    Introduction
    Problem Statement
    Alternatives
    Legislative History
    Policy Proposal
    Ethics and Personal Opinion

Part 2: Letter to Governmental Representative

1. Maximum of 2 single-spaced pages at 12 point font and 1 inch margins.
2. Should be a very condensed version of the Research paper.
3. Written as a personal communication that has an advocated position stated at the end.
4. Submit number of signed copies based on Representatives to be sent letter.
5. Submit addressed envelopes with return address but ***DO NOT INCLUDE POSTAGE***.

Grading rubric:

Section	Description	Points
Introduction	Adequately sets the stage – may use examples.	5
Problem Statement	Specific delineation of issues to be addressed.	10
Alternatives - List	List of options (quantity, not quality, matters most).	5
Alternatives - Evaluation	Detailed analysis of at least 3 (include reference data).	15
Legislative History	May be local, state, federal, or international.	10
Policy Proposal	Clearly details and presents advocated course of action.	15
Ethics	Addresses the moral issues related to policy.	5
Personal Opinion	Expresses individual views and reason for advocacy.	5

| Letter | Ability to succinctly summarize complex information. | 15 |
| Format and Grammar | Appropriate technical writing style (except PO section). | 15 |