AC 2007-1724: USING A HYBRID CLASSROOM ENVIRONMENT FOR THE INSTRUCTION OF ETHICS AND CONTEMPORARY CIVIL ENGINEERING ISSUES

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Using a Hybrid Classroom Environment for the Instruction of Ethics and Contemporary Civil Engineering Issues

Abstract

Every ABET accredited civil engineering program has to consider how to successfully measure whether its students attain the program outcomes, including ABET mandated outcomes (a) – (k), which include what many consider to be "soft" outcomes since they are not based on scientific or technical knowledge. ABET outcomes included in this category are: *an understanding of professional and ethical responsibility*; *an ability to communicate effectively*; *the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context*; *a recognition of the need for, and an ability to engage in life-long learning*; and *a knowledge of contemporary issues*. In addition, ASCE advocates the adoption of the Body of Knowledge (BOK) by civil engineering programs, which includes additional "soft" outcomes on public policy and leadership. How to insure students are obtaining these outcomes is obviously program specific and many programs struggle with how to include these outcomes in an already "packed" technical curriculum. As such, there are numerous pedagogical approaches for teaching ethics and/or contemporary issues with a wide range curriculum implementation strategies including modules, individual courses, integration throughout the curriculum, or as part of a capstone experience. This paper will describe an approach implemented by a private technologically focused University to reinforce ethical behavior and to discuss a wide range of contemporary issues associated with the above outcomes. The approach includes offering the course as a hybrid e-Learning course that is student learning focused and not instructor focused. Assessment of student learning and the effectiveness of the hybridization of the course will also be discussed in the paper.

Introduction

The Accreditation Board for Engineering and Technology (ABET) requires that ABET accredited civil engineering programs measure whether their students attain program outcomes, including ABET mandated outcomes (a) – (k), which include what many consider to be "soft" outcomes since they are not based on scientific or technical knowledge[1]. ABET outcomes included in this category are: *an understanding of professional and ethical responsibility*; *an ability to communicate effectively*; *the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context*; *a recognition of the need for, and an ability to engage in life-long learning*; and *a knowledge of contemporary issues*. In addition, the American Society of Civil Engineers (ASCE) advocates the adoption of the Body of Knowledge (BOK) by civil engineering programs, which includes additional "soft" outcomes on public policy and leadership. Specifically, the Civil Engineering Department at Lawrence Technological University offers a program in which our graduates have:

(a) an ability to apply knowledge and principles of mathematics, science, and engineering in the solution of civil engineering problems
(b) an ability to design and conduct experiments, as well as to analyze data and interpret results

(c) an ability to design a civil engineering system, component, or process to meet desired project needs
(d) an ability to function on multi-disciplinary teams including participation in a senior-level design project sequence
(e) an ability to identify, formulate, analyze, and solve engineering problems
(f) an understanding and appreciation of all aspects of professionalism including ethical responsibility, participation in professional organizations, and service
(g) an ability to communicate effectively developed through report writing and in-class presentations
(h) the broad education necessary to understand the impact of engineering solutions in a global, sustainable, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
(l) an ability to apply the fundamentals of civil engineering to the analysis of an existing project component
(m) an understanding of the benefits of passing the FE exam and becoming a licensed professional

In the above list, (a) – (k) are patterned from ABET (a) – (k) with a few program modifications. Outcomes (l) and (m) are unique to our civil engineering program and were added based on discussion with program constituents. In addition, the BOK recommends four more outcomes:

- an ability to apply knowledge in a specialized area related to civil engineering.
- an understanding of the elements of project management, construction, and asset management.
- an understanding of business and public policy and administration fundamentals.
- an understanding of the role of the leader and leadership principles and attitudes.

The BOK outcomes have not been officially adopted by our department, but are considered important and addressed in the curriculum. The department program outcomes in **bold** in the above list (***f, g, h, i, j,*** and ***m***) are the one specifically addressed by the course being discussed in this paper.

How to insure students are obtaining these outcomes in an already "packed" technical curriculum can be a challenge. Accordingly, there are numerous pedagogical approaches for teaching ethics and/or contemporary issues with a wide range curriculum implementation strategies including modules, individual stand alone courses, integration throughout the curriculum, through extra curricular experiences, or as a component of the required capstone experience. The approach taken by the author's department was to utilize a stand alone senior level course to reinforce ethical behavior and to discuss a wide range of contemporary issues associated with the above outcomes. The key idea, of course, is to reinforce these topics immediately prior to graduation. The Civil Engineering Department at Lawrence Tech covers these outcomes in other courses beginning with an introductory course the freshman year and culminating with the capstone experience. However, this course brings these concepts into a single forum and also allows for assessment of these particular program outcomes. However, after the author taught the course for the first time in spring of 2005 using a traditional lecture format, I decided to expand the impact of the course by modifying the course into include an e-Learning component.

Course Description

The course in question is ECE4051 Ethics and Professional Issues. The course is a required senior level civil engineering course that addresses a wide range of issues that engineers are likely to face during their careers. Such issues include the conflict between engineers' duty to the public, their employer, and themselves. Approximately, 10 to 20 civil engineering students enroll in this course each semester. Prior to the fall of 2005, the class was taught in a lecture/seminar format and met nearly every week for one hour at a time. As such, the course included instructor lectures, occasional guest speakers, an ethical video (Gilbane Gold), and intermittent student discussion sessions. The course has always been used to address several of the "soft" outcomes associated with ABET EC2000, but the modified course expanded the coverage of the outcomes such that learning is deepened and impact was broadened. While this course is not the sole conduit of information on the above outcomes, it is the primary mechanism for outcome inclusion in the curriculum and serves as a direct assessment vehicle to ensure coverage of the program outcomes in question.

The course described in this paper was redesigned in 2005 to shift from instructor focused to student learning focused and, more significantly, to be offered as a hybrid e-Learning course with 40% of the course facilitated online and 60% in a classroom. These modifications decreased class lecture time and expanded the learning experiences of the students. This one-credit course meets once every 3 weeks for group discussion on the module completed prior to meeting. During the physical course meetings, the instructor moderates student discussion and therefore is not the sole source of information or learning. The course management program, Blackboard, facilitates the hybrid component. Blackboard is used to post and receive assignments, link students to sources of information, facilitate monitored online discussion forums between class meetings, for viewing of streamed video, and to conduct online surveys and quizzes. The goals associated with modifying the course into a hybrid e-Learning environment were:

> *Goal 1: Modifying an existing lecture format instructor focused course to a hybrid student learning focused course.*
> *Goal 2: Provide students with expanded learning experiences, to learn from each other as well as the instructor, and to enrich the educational experience.*
> *Goal 3: Provide students with an opportunity to experience e-Learning, which will likely become a component of their continuing education upon graduation.*
> *Goal 4: Provide students with a better opportunity to review and critically critique streaming video, public opinion pieces, and published articles on topics relative to the civil engineering profession.*

Using this format, students are learning about and forming their own opinions on contemporary issues such as ethics, sustainability, the BOK, licensure, public advocacy, whistle blowing, ethical and professional obligations, professional societies, community service, and more. In addition, students are required to participate in professional development activities by attending ASCE meetings, participating in continuing education programs, and participating in community

service events. This further increases the level of achievement of the course objectives, which should be met by all students. Specifically, the published course objectives are listed below.

By the end of this course, a student should be able to:

1. *Describe and differentiate between basic tenets of the NSPE Code of Professional Conduct and the ASCE Code of Ethics.*
2. *Apply the provisions of the ASCE and/or NSPE Code of Professional Conduct to ethical dilemmas, and recommend the most appropriate course of action.*
3. *Develop and demonstrate critical thinking and writing capabilities with respect to ethical dilemmas and professional topics.*
4. *Describe the impact of engineering solutions in a global, sustainable, and societal context.*
5. *List and discuss the many aspects of professionalism including behaving ethically, participating in professional organizations, and serving society and the profession.*
6. *List and discuss the benefits of ASCE membership for a civil engineer.*
7. *Explain the role of ASCE in promoting, serving, and protecting the civil engineering profession.*
8. *Write an advocacy letter to an elected official taking a position on the topic related to our profession.*
9. *Describe the benefits of passing the FE exam and becoming a licensed professional along with the process of becoming professionally licensed in the State of Michigan.*

Hybrid Facilitation

The primary mechanism for making the course a hybrid course is the course management software, Blackboard[2]. Blackboard is a proprietary web-based tool that allows students to interact with the instructor and each other. In many courses, Blackboard is used to post duplicates of materials distributed in class, for making announcements, and for entering student grades. In this course, the Blackboard features utilize to facilitate the hybrid component include posting **assignments and materials, web links, digital dropbox, assessment/survey feature,** and **discussion forums,** and **streaming video.**

Previously, **assignments** were handed out in class along with the **materials** required to complete the assignments. Materials typically include journal articles or public PDF documents, which were scanned (if only hard copies were available), printed, and distributed in class. In the current hybrid course, this is completely handled electronically using Blackboard. The assignments and all of the required readings are posted online along with website links to additional required materials. The **digital dropbox** feature is used to collect and return a portion of the assignments. A majority of assignments associated with this course are writing assignments in the form of technical memos and reflective essays. Students are asked to read and analyze a technical article or professional code and submit a summary or opinion. As such, this process can be handled electronically.

The **survey** feature of Blackboard is utilized for students to complete online quizzes after modules of the course have been completed. The survey feature is utilized for end of term learning objective evaluation, assessment of hybrid techniques, etc.

The Blackboard feature that has the most significant impact on the hybridization of the course is the **discussion forum.** Forums are created and student usage is tracked and assessed. This facilitates discussion between class meeting times. Examples of the discussion forum usage are provided later in the paper.

The course includes several videos and instead of the videos being shown in class, they are streamed and viewable online. Since the student are required to read, reflect, and write about the video content, it helps to view the videos multiple times as opposed to once or twice as was the case before **streaming video** was utilized. Students can now watch the videos on their own time and can pause and reverse as necessary to capture information. This method releases course time and should increase student learning since they are able review and analyze the information at their own pace.

Assignments/Modules

The course is segregated into topical modules that include: *Introduction to Ethical and Moral Theory* (1 lecture), *Application of Professional Codes of Ethics* (2 lectures and online discussion), *Licensure* (1 lecture), *ASCE and the Civil Engineering Profession* (1 lecture, online discussion, and professional meeting attendance), and Sustainability (1 lecture and online discussion).

Introduction to Ethical and Moral Theory

On the first course meeting, the expectations for the course are covered and students are introduced to ethical and moral theory by completing a rights & responsibilities exercise. This exercise was modified from an ethics module utilized at the University of Puerto Rico – Mayaquez[3]. In this assignment, students' work in teams to answer questions such as "What is ethics?" and "How does ethics differ from morals?". In addition, student teams are asked to generate several lists including the duties that professors have to students, the duties students have to professors, the duties students have to each other, and the duties students have to society. These lists are shared and discussed in class. The exercise is repeated by listing student and professor "vices" and "virtues." In between the teamwork exercises, some basic concepts of ethical and moral theory are covered and definitions are generated. This is important to establish the tone of the course – one of discussion, debate, and general consensus. Typically, the students rapidly realize that they are, in fact, generating a code of ethics for the class by discussing the rights and responsibilities of the students and the professor. This also sets the stage for how codes of ethics are introduced into the course and how those codes have evolved over time. In addition, while the coverage of moral theory is limited to this one session, it's important for the students to be exposed to the topic of moral theory. In fact, its been argued that the lack of including classical moral theory in the engineering curriculum is the single largest problem with regards to producing ethical engineers[4 5].

Application of Professional Codes of Ethics

After the first classroom meeting, students are asked to prepare a professional executive memo addressed to the instructor that compares and contrasts the National Society of Professional Engineers (NSPE) "Code of Ethics for Engineers" and the American Society of Civil Engineers (ASCE) "Code of Ethics". This comparison, which must include specific references to each code highlights the similarities and differences both in terms of content, structure, and language. Finally, they are asked to address as a future professional engineer and also a civil engineer, which code they should uphold and seek guidance from. The second classroom meeting includes a discussion of the code applicability based on their reflections and how to find guidance in the codes for ethical dilemmas. Using the online Blackboard discussion forum reinforces this discussion. The instructor will post an ethical dilemma in the forum and ask the student to reflect and respond on how they believe the situation should be handled included specific code references. The dilemmas are commonly modified from ASCE published literature including "ASCE Guidance for Civil Engineering Students on Licensure and Ethics"[6] and the "A Question of Ethics – A Case Study" published monthly in the ASCE News. However, some cases have arisen from personal experience and one case was even posted by a student enrolled in the class. Since posting to the discussion forum is a required and graded component of the course, the students do a very good job of reflecting, writing in a professional manner, and citing the codes. The dialog tends to be spirited but non-threatening and, as is the case with any ethical dilemma, there is a "grey" nature to the dilemma, which leads to good discussion. The instructor monitors the discussion forum daily, but typically only posts if some element of the case hasn't been covered or to play "Devil's Advocate" if the students are in general agreement and not delving "deep" enough into the case. Once the case has been thoroughly analyzed, a new dilemma is posted and the process starts over. This is continued for 3 to 4 weeks. As an example of a Blackboard forum discussion (with student names removed):

> Student 1: *I believe that Sara (the subject in the story) was right by returning the gift that was sent to her. According to Canon 4c of the ASCE Code of Ethics, "Engineers shall not solicit or accept gratuities, directly or indirectly, from contractors, their agents, or other parties dealing with their clients or employers in connection with work for which they are responsible." Gratuity would normal mean money, but in this case it would apply to the gift basket. I'm sure that Sara wouldn't have treated the vendor any differently had she kept the basket, however, she felt that it was unethical and didn't want to get in trouble if by chance it wasn't allowed. Furthermore, ASCE Canon 6c states, "Engineers shall act with zero-tolerance for bribery, fraud, and corruption in all engineering or construction activities in which they are engaged". This gift basket could be considered bribery, even though that may not have been the intention. Therefore, in the end, it was the best decision for her to kindly return it, removing her from any complications in the future that would result from the gift.*
>
> Student 2: *I agree that Sara made the ethical choice to return the Christmas gift. As Student 1 mentioned, it is clearly stated in the ASCE Code of Ethics Canon 6cthat "Engineers shall act with zero-tolerance for bribery, fraud, and corruption in all engineering or construction activities in which they are engaged". That is not to say that*

this particular vendor was using this gift as a corrupt attempt at bribery, but there is clearly a grey area that this gift may fall under. While one may not be able to definitely say that it is an attempt at bribery, at the same time, one cannot say that it is definitely not. I found it particularly interesting that the vendor gave multiple employees this same gift. It would be one thing for the vendor to give a single employee a gift of gratitude for his or her personal advice. However, it seems that giving multiple gifts to many individuals in the same company seems like it may be an attempt to sway the company into favor.

Student 3: *I do not think that Sara was obligated to return the gift basket. The ASCE code of ethics states in Canon 6, part D that "Engineers should be especially vigilant to maintain appropriate ethical behavior where payments of gratuities or bribes are institutionalized practices." I would consider this a gratuity for using this vendor in the past and it would be up to Sara to determine if this gift was out of line since there is no rule against accepting it. In my work place, gift baskets are extremely common when the holidays roll around and I don't believe any of them have ever been sent back however we do not give those who send them special treatment. I would view it as a gift of appreciation for using them in the past and nothing more.*

Student 4: *I agree with Student 3 that Sara was not obligated to return the holiday basket to the vendor. As stated in the ASCE Code of Ethics Canon 5: Engineers shall not give, solicit or receive either directly or indirectly, any political contribution, gratuity, or unlawful consideration in order to secure work, exclusive of securing salaried positions through employment agencies. However, this specifically states "to secure work." Since the company had already been a client of the engineering firm, there is not necessarily a reason to have the need to secure work. Furthermore, with any type of company, especially in today's society, marketing is a necessity. If a company does not attempt to advertise itself and make itself known by others, it cannot gain business. Other co-workers had also received this gift. If nothing else, this gift was a means to thank the engineering firm for their previous business, and to make the firm aware that they are still interested in working with them in the future.*

The above four posts occurred in less than four hours on the forum and in the order presented. It's easy to discern that the students are reading and reacting to each other in addition to the case study posted by the instructor. Its also easy to discern the grey area in this case since students 3 and 4 stated they disagree (respectfully) with students 1 and 2. Finally, it's also easy to for the instructor, who moderates and grades the discussion, to assess the quality and quantity of the posts.

The second opportunity for student to analyze and resolve ethical dilemmas is through the well utilized Gilbane Gold video[7] produced by the National Institute of Engineering Ethics[8] and the NSPE[9]. The video is streamed for repeated viewing through the secure course Blackboard site and the students complete a fairly lengthy discussion memo submitted online prior to the course meeting. The questions the students are asked to address in the memo have been modified from NSPE publications and include questions on ethical and legal and behavior, whistle blowing, different characters competency in dealing with the situation, and personal responsibilities. At

the third course meeting, the students discuss their reactions to the case study and analyze the case. Typically, the discussion is deeper than many students originally thought. For example, one question for consideration is:

> *Assuming the facts as they are in the movie, could Diane be accused of acting unethically? Why or why not? Does her ". . . broader responsibility to the public . . ." statement carry any weight? Why or why not?*

Licensure

Instead of lecturing the students on the process of licensure, the students are asked to prepare an executive memo addressed to the instructor describing the process an engineering undergraduate student would take to become a licensed professional engineer in the state of Michigan and are asked to include information from the National Council of Examiners for Engineering and Surveying[10], the State of Michigan[11], and the ASCE website. In addition, students are also asked to read opinion pieces from NCEES and ASCE on the benefit of licensure and to write a reflective statement on of what it means personally and professionally to be a licensed civil engineer, the benefits associated with being licensed, and a personal statement of why they do or do not intend to pursue licensure. They submit their reflective memo before the fourth class session. The licensing process and the benefits associated with licensure is reviewed for clarity during the fourth course meeting time.

ASCE and Civil Engineering Profession

Since discussion on licensure does not require an entire course session, the second half of the fourth class meeting time is devoted to brainstorming on the issues facing the civil engineering profession as the students see them. By the end of the course, a fairly comprehensive list is developed that is recorded and disseminated back to students through Blackboard and discussion is continued through the discussion forum.

In addition, the students have one comprehensive assignment associated with this topical area. The students are asked to read the Executive Summary of the ASCE Body of Knowledge[12] and two editorial articles about the BOK[13] [14]. These materials are posted in the Blackboard for easy digital access. The students are then asked to prepare a two page reflective essay about the BOK that includes an overview of the BOK as well as a personal reflective statement. The reflective component is their opinions/thoughts on the BOK. Students are specifically asked to refer to the BOK and associated editorials as part of the essay, especially if they influence their opinion on the BOK. In conjunction, the students are asked to read ASCE Policy 465[15] and prepare a short (one or two paragraphs) opinion piece on whether you are for or against the policy. Finally, the students also read Professional Issues in Civil Engineering in the 21st Century[16] and an executive summary of the Engineer of 2020[17]. All necessary materials are posted in Blackboard and the fifth class meeting time involves discussion on their analysis of the readings.

In addition, at the beginning of the semester, the students are assigned to attend ***three*** professional meetings during the course of the semester. On campus, ASCE student chapter business meetings with speakers are eligible as professional meetings, but they are limited to ***two***

ASCE student meetings such that they seek other venues for professional development. This assignment also serves as a vehicle for introducing concepts such as continuing education, networking, service, and professional development to the students during their careers. Off campus professional meetings attended have included ASCE Branch or MSPE sponsored technical meetings and tours, ASCE Branch business meetings, zoning board and council approval meetings, and other regionally sponsored special interest engineering workshops on discipline specific advancements (such as porous pavement, CFRP, in place asphalt recycling, etc). For each meeting, the students are asked to write a brief reflective statement of the meeting (one paragraph), and a personal reflection of what they ***professionally and personally*** gained from attending the event. This assignment is submitted before the end of the semester through the digital dropbox.

The final assignment associated with ASCE and the civil engineering profession is an assignment on political advocacy. The students are introduced to ASCE statements on professional hot topics through the ASCE Advocacy website[18] and are asked to write a letter to an elected government official(s) regarding a civil engineering issue of their choice. To complete the assignment, the students must mail, email or fax a copy of the letter to their elected official and submit a copy in class. The students are also introduced to the "Six Clicks to Write your Legislator" through ASCE website. They are instructed that they may choose to use the template provided by the ASCE advocacy website as a starting point, but they are expected to personalize the letter with their signature, the fact they are an engineering student at Lawrence Tech University, and at least one local talking point. This assignment also serves to enlighten them on how few elected officials have science, technology, engineering, and mathematics (STEM) backboards and the importance of advocacy to the civil profession, which is closely connected to elected officials through funding and regulations. This assignment also embodies a portion of the BOK outcomes on public policy and leadership, which are discussed and reinforced through this article.

Sustainability

The incredibly important topic of sustainability and the global and societal impacts of civil engineering projects are covered in the final class session. This topic could easily demand multiple sessions and obviously entire courses have been developed to teach sustainability in the civil engineering profession (including elective courses at the author's institution), but course constraints limit the amount of time spent discussing sustainability. However, the coverage, while limited, is important because does provide an overview of the topic and its relevance to the profession and insures that every graduate has a basic knowledge of the issues. The course has also inspired some students to seek additional technical electives that include a sustainable focus.

Prior to attending class for the discussion portion, the students are asked to watch "William McDonough on Sustainability" by Detroit Autoline[19]. This video is a one-hour interview with sustainability guru William McDonough conducted on a local community access program. The interview was purchased and streamed onto Blackboard for the students to watch and answer questions on their own time. The questions include:

How does McDonough define sustainability?
Explain the McDonough quote, "Consumers with lifestyles instead of people of lives."

Explain the McDonough quote. "A regulation is an example of a design failure." McDonough explains the economics of workplace is about people not the building. How does green building promote increased revenues even though they cost more initially? McDonough advocates modeling a site as an ecosystem. What are some of the green design features of the Ford Rouge Plant?

The students are also assigned to read and turn in a reflective memo on several articles posted on Blackboard[20] [21]. The articles include examples of Leadership in Energy Efficient Design (LEED) construction projects, information about the LEED certification process and the US Green Building Council (USGBC) website[22], and booklet published by the Nature Conservancy on conservation site design[23]. All readings are posted in Blackboard and the students are asked to write either reflective essays or professional executive memos on the topics and submit them via digital dropbox.

The final assignment is for the students to answer the following question based on everything they have read, discussed in class, and discussed in the discussion forum: "What do civil engineers need to understand about the impact of their engineering solutions in a global, sustainable, and societal context?" This provides a direct assessment vehicle since this is one of our published program outcomes.

Strategy for Assessing Student Learning

Course assessment includes assessment of student learning, overall student satisfaction with the course and instructor, and the effectiveness of the hybrid component of the course. Student learning is assessed both directly and indirectly. Direct assessment of student learning occurs through evaluation of graded projects. The projects have been designed to specifically address program outcomes as was indicated by the italics in the list. Indirect assessment occurs through student surveys at the end of the term.

The direct assessment occurs through randomly selecting and analyzing student work as a performance appraisal. The instructor will select 4 students' names randomly (approximately 1/3 to 1/2 of the class) at the beginning of the course (using a random number generator). For these four students, a copy of each assignment submitted is collected. At the end of the term, the instructor subjectively assesses student work to determine to what degree the program outcome was met. This is accomplished utilizing a five point scale from 1…5. The instructor will submit copies of the student work along with a cover sheet that includes a summary analysis to the department faculty for review. This process is documented and included in the annual department assessment report indicated level of student achievement of that course objective. As status check on whether the students selected were representative of the classroom, the students overall GPA and their grade in the class is recorded and compared with class statistics on these items. A sample of the cover sheet from the fall 2006 semester can be found in the Appendix. An additional direct assessment employed by the department is the FE Exam results, but not enough offerings of the hybrid version of the course have occurred with corresponding FE Exam results for a comparison to be made at this time.

Indirect assessment of student learning is accomplished through online course objective surveys that question students on their ability to complete course objectives. Overall student satisfaction with the course and the instructor is through the end of the term course evaluations administered by the dean's office. Finally, the effectiveness of the hybrid component of the course is through an online survey that questions the students about the hybrid components of the course as well as through informal focus groups during the last course meeting.

The author is aware of the limitations of this assessment plan with regards to assessing learning based on a hybrid environment. However, the assessment plan, while not of educational research caliber, is adequate to determine the effect of the course modifications and direct assessment of learning associated with course objectives has shown an increase in student learning and the documents are archived for the next ABET accreditation visit.

As previously mentioned, indirect assessment of student learning is accomplished through an online survey that questions students on their ability to complete course objectives. Students are asked to rate their ability to perform each course objective on a 5 point Lickert scale from "strongly agree" to "strongly disagree." This survey is conducted for all civil engineering courses to indirectly assess student learning and to track whether students feel course objectives are being met. These results are tabulated and shared with the entire department and with course instructors. The instructors are also asked whether they feel course objectives are being met to determine if there is a discrepancy between student and instructor opinions. The surveys are voluntary and anonymous, but the importance of the survey is clearly explained to the students so response rates are typically between 75% and 100% for most courses.

The results from the course objective survey for ECE4051 Ethics and Professional Issues are shown in Figure 1. Figure 1 has the percentage of students who agree or strongly agree with their ability to perform each of the course objectives during the three semesters for which the course has been offered in the hybrid format. The figure also includes two learning objectives (*List and understand the ethical and legal requirements when serving as an expert witness*; and *Reflect upon and describe your capability to understand and apply the design process for the solution of a problem*), which were removed from the course in spring of 2006 and replaced by three new objectives (*List and discuss the benefits of ASCE membership for a civil engineer; Explain the role of ASCE in promoting, serving, and protecting the civil engineering profession;* and *Write an advocacy letter to an elected official taking a position on the topic related to our profession.*).

This figure clearly shows that only once (one objective in one semester) was student self assessed ability less than 100%. In that particular case, it was only a single student and their response was "neutral" so they were not in disagreement. To better illustrate this point, Table 1 contains the same information, but with the percentage of students who agreed versus strongly agreed separated. The table also shows the number of students who completed the survey versus the number enrolled in the class. In three semesters, 28 out of the 34 students (82.4% response rate) complete the survey. It should be noted that the results from this course are not typically of all civil engineering courses. It is very common for students to indicate they are not capable of performing one or more of the course objectives in other courses so the high response rates in this course are not a project of students blindly agreeing with every statement.

The effectiveness of the hybrid component of the course was also included as part of the course objective surveys. Table 2 has the percentage of students agreeing with statements on the hybrid nature of the course, which included statements on, whether they enjoyed the hybrid nature of the course, whether they thought it was conducive to their learning, and whether they thought the level of work was appropriate. This survey was conducted twice (during the first two offerings of the course) and students overwhelming agree with each question. In addition, while not presented here, the end of term student surveys conducted by the College of Engineering Dean's Office include questions on course and instructor effectiveness and the results were similarly positive.

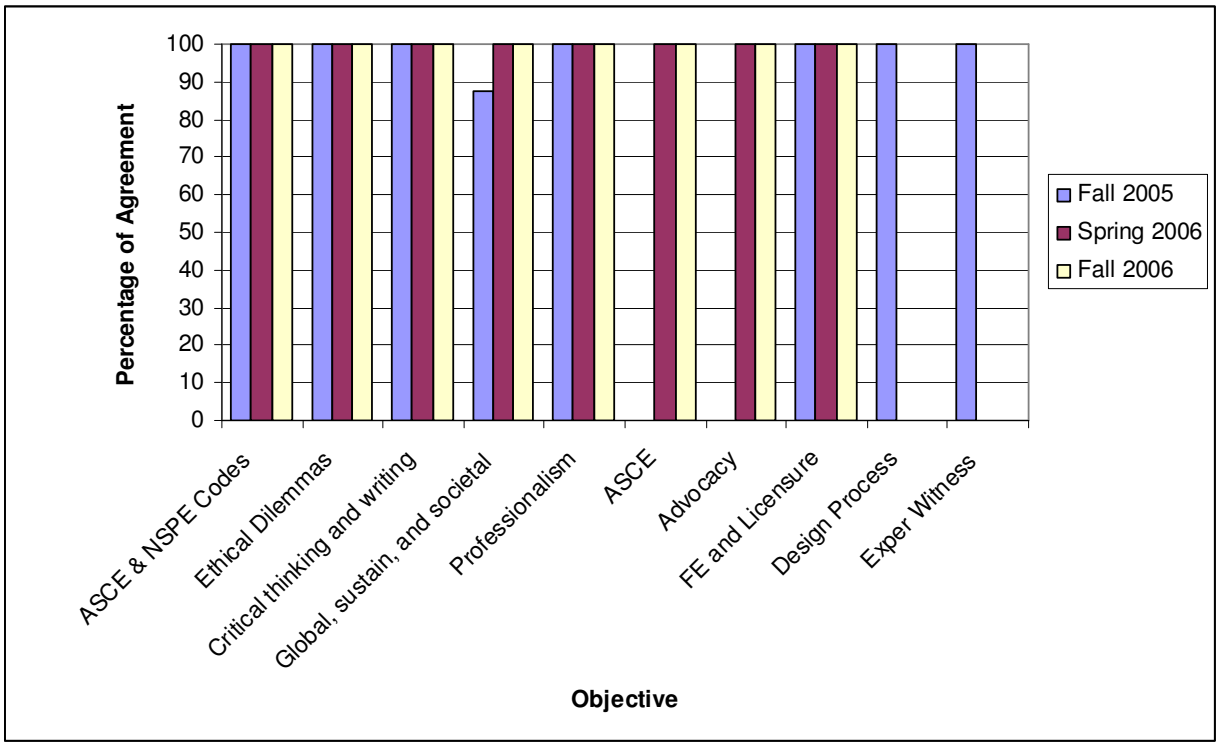

Figure 1: Percentage of students capable of performing course objectives.

Table 1: Percentage of students indicating the capability of performing course objectives.

	Fall 2005 8 out 9 students			Spring 2006 6 out of 9 students			Fall 2006 14 out of 16 students		
Objective	Very Capable	Capable	Neutral	Very Capable	Capable	Neutral	Very Capable	Capable	Neutral
1) ASCE & NSPE	50	50	0	83.3	16.7	0	35.7	64.3	0
2) Ethic Dilemmas	62.5	37.5	0	83.3	16.7	0	57.1	42.9	0
3) Critical Thinking	50	50	0	83.3	16.7	0	57.1	42.9	0
4) Global/Sustain	37.5	50	12.5	83.3	16.7	0	50	50	0
5) Professionalism	62.5	37.5	0	66.7	33.3	0	57.1	42.9	0
6) Benefit of ASCE	-	-	-	66.7	33.3	0	42.9	57.1	0
7) Role of ASCE	-	-	-	66.7	33.3	0	42.9	57.1	0
8) Advocacy	-	-	-	66.7	33.3	0	42.9	57.1	0
9) FE & Licensure	62.5	37.5	0	100	0	0	64.3	35.7	0
10) Expert Witness	25	75	0	-	-	-	-	-	-
11) Design Process	37.5	62.5	0	-	-	-	-	-	-

Table 2: Percentage of students agreeing with statements on the hybrid nature of the course.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I enjoyed the hybrid nature of this course.					
Fall 2005	100	0	0	0	0
Spring 2006	66.7	33.3	0	0	0
The hybrid nature of this course was conducive to my learning.					
Fall 2005	33.3	50	16.7	0	0
Spring 2006	66.7	33.3	0	0	0
The level of work associated with this course is about right.					
Fall 2005	50	50	0	0	0
Spring 2006	50	50	0	0	0

Conclusion

In conclusion, the ECE4051 Ethics and Professional Issues course has been proven effective at addressing and reinforcing a significant number of the "soft" program outcomes. In addition, offering the course in a hybrid e-Learning environment has enhanced both the breadth and depth of coverage of the course objectives, which are related to the program outcomes. The hybrid nature of the course has also been well received with the students who are not accustomed to online, hybrid, or distance learning within the college of engineering at the author's home institution. Finally, the course serves as a direct assessment vehicle for the soft program outcomes. As such, this course can serve as a model for other institutions that are trying to cover additional "soft skills" in a typically packed technical curriculum.

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Bibliographical Information

[1] *ABET*, http://www.abet.org/
[2] *Blackboard*, https://www.blackboard.com/
[3] Jimenez, L.O., E. Neill-Carrillo, and E. Marreeo (2005). "Creating ethical awareness in electrical and computer engineering students: A learning module on ethics," *Proceedings of the 35th ASEE/IEEE Frontiers in Education Conference*.
[4] Haws, D. R. (2001). "Ethics instruction in engineering education: A (mini) meta-analysis," *Journal of Engineering Education, 90(*2), 223–229.
[5] Haws, D. R. (2004). "The importance of meta-ethics in engineering education," *Science and Engineering Ethics, 10*(2), 204–210.
[6] "ASCE Guidance for Civil Engineering Students on Licensure and Ethics", *American Society of Civil Engineers*, https://www.asce.org/pdf/ethics_student_guide.pdf
[7] "Gilbane Gold. An ethics story focusing on the responsibilities of engineers," *National Institute for Engineering Ethics*, https://www.niee.org/pd.cfm
[8] *National Institute of Engineering Ethics*, https://www.niee.org/
[9] *National Society of Professional Engineers*, https://www.nspe.org/
[10] Licensure for Engineers, *National Council of Examiners for Engineering and Surveying*, http://www.ncees.org/licensure/licensure_for_engineers/
[11] Professional Engineers Licensure, *Michigan Department of Labor and Economic Growth*, http://www.michigan.gov/cis/0,1607,7-154-10557_12992_14016---,00.html
[12] "Civil Engineering Body of Knowledge for the 21st Century", *American Society of Civil Engineers*, http://www.asce.org/professional/educ/bodyofknowledge.cfm
[13] Rubin, R. (2004). "Reaching Beyond the Technical," *Engineering News Record*, December 6th, 2004, pg 26 - 27.
[14] Editor's Note (2004). "Industry and Academics Need to Hunt For Success," *Engineering News Record*, December 6th, 2004, pg 64.
[15] "Key Points of Policy 465," *American Society of Civil Engineers*, http://www.asce.org/pdf/KeyPoints-PS465-V19-100305.pdf
[16] "Professional Issues in Civil Engineering in the 21st Century," *American Society of Civil Engineers*, http://www.asce.org/pdf/ceprofessional.pdf
[17] "Executive Summary – The Engineer of 2020," *National Academy of Engineering*, http://orsted.nap.edu/execsumm_pdf/10999
[18] ASCE's Internet Advocacy Website, *American Society of Civil Engineering*, http://www.asce.org/pressroom/publicpolicy/advocacy.cfm
[19] Autoline Detroit (2004). "An interview with William McDonough on Sustainability," Blue Sky Productions, Livonia, MI.
[20] Editor's Note (2004). "Chicago Center for Green Technology is the first municipal building to receive LEED platinum rating," *Environmental Design & Construction*, Jan/Feb, 2004, pg 7 –8.
[21] Chapman, L. (2004). "Transforming a Neighborhood," *Environmental Design & Construction*, Jan/Feb, 2004, pg 68 - 71
[22] *US Green Building Council*, http://www.usgbc.org/
[23] *Conservation Development in Practice* (2003). Published by The Nature Conservancy and The Conservation Design Forum.