2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #36787

Strengthening Undergraduates' Appreciation of Engineering Ethics through a Simulated Stakeholder Meeting on Offshore Wind Energy Development

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Abstract

The need for deepening students' appreciation for the importance of engineering ethics remains ever present. However, accomplishing this learning outcome can be challenging, as the principles often come across as abstract and distant to many undergraduates. To combat these challenges, a group-based assignment and corresponding in-class role-playing activity were developed for an upper-level ocean engineering elective course, based on a local case study about offshore wind energy development. The new pedagogical approach aims to present engineering ethics in a more tangible and relatable way by requiring students to role-play a real-world scenario from their own university's backyard. Students worked on small teams to represent six stakeholder groups – transportation regulators, recreation and tourism, developers and engineers, commercial fisheries, as well as the pro- and anti-wind factions of the public – tasked with selecting the next location for an offshore wind farm. To prepare for the in-class activity, each team crafted an opening statement based on individualized dossiers provided by their instructor, as well as through performing their own independent research. During class, a stakeholder meeting was simulated, beginning with opening statements and site proposals from each team, followed by a round of negotiations and rebuttals, with the ultimate goal of agreeing on a location for development. Following the in-class exercise, students completed individual reflections to self-assess growth in their knowledge and skill development from participating in the simulated meeting. This paper presents the assignments and lesson plan for the newly created ethics role-playing activity, which could be adapted to represent the pressing engineering development issues relevant to any region. Further, this work explores the efficacy of this new pedagogical approach in meeting learning outcomes related to engineering ethics by analyzing student reflections following their participation in the role-playing exercise. Qualitative analysis of student work demonstrates deep engagement with the material, growth in performing research, and strengthened communication skills. Lastly, suggestions for improving the ethics role-playing activity and corresponding assignments are provided.

Introduction

Establishing and strengthening undergraduates' appreciation for the complexities and importance of engineering ethics is a persistent need and challenge for engineering educators. Finding ways to instill an understanding of engineering ethics in a sincere, deep, and substantial way can be challenging. Often, students find the material to be distant and abstract. In seeking to overcome these challenges in a senior-level elective course at a small engineering program, a new role-playing exercise was introduced.

Educators across a wide range of engineering disciplines continue to turn to role-playing activities as a pedagogy to meet a variety of learning outcomes, as it is well-documented to increase and maintain student engagement, while also advancing the attainment of new skills and knowledge [1], [2]. One of the primary drivers, similar to the goal of this work, is to enhance

students' appreciation for engineering ethics, as well as social justice issues [2], [3], [4]. Educators are also seeking opportunities to strengthen their students' skills, such as communication [3], decision-making, ability to work on interdisciplinary teams, and understanding multiple perspectives [5]. These skills are sometimes more explicitly focused on professional skills such as conducting job searches, giving sales pitches, and performing research & development [6]. Additionally, role-playing games are being adopted for teaching engineering concepts, such as statics, material properties, mass balances, and design [3].

There is a wide range of formats for role-playing pedagogies, giving educators the ability to adapt and amend the activities to suit the needs and goals of their individual courses and students. Many examples involve the use of class time for a role-playing activity, in lieu of a more traditional lecture. These in-class activities may take the form of a game, simulated meeting, mock interview, or sales pitch, to name a few [3], [7], [8]. Some instructors have coordinated multiple courses to interact through a role-playing exercise, including two courses in engineering [6] and even interdisciplinary engagement with law students [4]. Others have selected online environments for their students to interact with role-playing activities [1], [2], [5].

Regardless of the format, many if not most role-playing activities include a written component – either as a report or self-reflection about their experience – an important component for students' metacognitive learning and a helpful tool for the instructors' assessment of their learning. The success of role-playing activities in enhancing students' skills, knowledge, and appreciation of engineering ethics is well documented, with assessment carried out in a variety of ways. Some authors use mixed methodologies by exploring survey results and student writing (often reflections) [1], [2], [3], [4], while other rely on just surveys [7] or student writing [5].

This work includes a qualitative assessment of students' reflections, following their participation in an in-class role-playing activity, to explore growth in skills, knowledge, and an appreciation of engineering ethics. The role-playing activity was designed for an upper-level elective course titled Ocean Hydrodynamics (prerequisites include differential equations and fluid mechanics), offered to students specializing in mechanical engineering in a small engineering program in the northeast. Students were assigned to various stakeholder groups, further described below, and tasked with participating in a simulated meeting to select the next location for an offshore wind farm. The role-playing activity was designed to bring realism to engineering ethics, which can often feel abstract or distant, by specifically selecting a scenario from the university's geographical region and related to the course content.

Background

In late 2016, the Block Island Wind Farm in Rhode Island became the first project to provide customers with offshore wind power in the United States [9]. Since then, two offshore turbines have been installed in Virginia [10], with many more projects on the horizon along the east coast [11], [12]. The selection of sites for wind farm development is complex – including securing leases from the Bureau of Ocean Energy Management (BOEM), completing environmental reviews, and interacting with stakeholders – to name just a few of the steps [13]. The role-playing activity sought to expose these complexities to the students, with an emphasis on the challenges related pleasing multiple stakeholders.

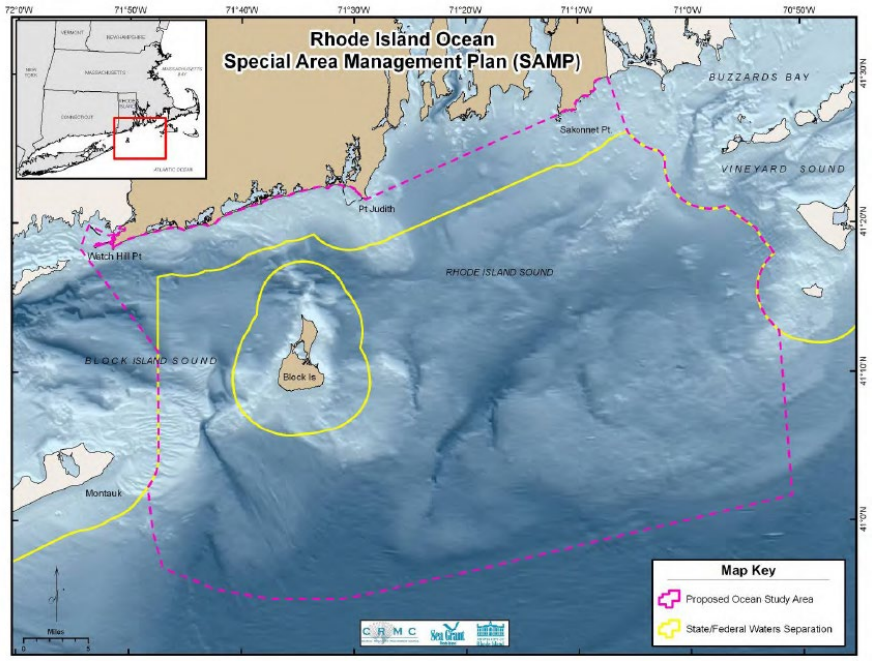

Figure 1: The proposed ocean study area from the RI SAMP also served as the geographical region under consideration for the in-class role-playing exercise [14].

The instructor's development of the activity leaned heavily on the Rhode Island Special Area Management Plan (RI SAMP), which provides guidance and recommendations to the Coastal Resource Management Council (CRMC) to support its commitment to protect the coastal resources of Rhode Island [14]. The document itself was an important factor in the development and installation of the Block Island Wind Farm and its chapters served as the inspiration for the stakeholder groups used in the role-playing activity. The chapters of the document are listed below to provide a quick sense of the impressive scope of the RI SAMP.

Chapter 1. Introduction
Chapter 2. Ecology of the SAMP Region
Chapter 3. Global Climate Change
Chapter 4. Cultural and Historical Resources
Chapter 5. Commercial and Recreational Fisheries
Chapter 6. Recreation and Tourism
Chapter 7. Marine Transportation, Navigation, and Infrastructure
Chapter 8. Renewable Energy and Other Offshore Development
Chapter 9. Other Future Uses
Chapter 10. Existing Statutes, Regulations, and Policies
Chapter 11. The Policies of the Ocean SAMP

The Assignment

Students were assigned to work on small teams representing six stakeholder groups, largely inspired by the organization of RI SAMP document [14]. The stakeholder groups included Commercial Fisheries, Developers and Engineers, Recreation and Tourism, Transportation

Regulators, Public Pro-Wind Farm, and Public Anti-Wind Farm. In the fall of 2022, each team was comprised of three students.

Students were instructed to meet with their team to prepare for a simulated stakeholder meeting to take place during a single 50-minute class period. The goal of the meeting would be to select a location to install a wind farm off the coast of Rhode Island. The proposed wind farm would include twenty 12 MW turbines. Each team would bring their own unique concerns, goals, and suggestions to the meeting, based on their assigned stakeholder group.

The assignment was organized into four deliverables, outlined in Table 1. The first two deliverables were team-based assignments due ahead of the simulated meeting. For the final two deliverables, students were graded individually based on their engagement during the simulated meeting and the quality of their reflections after the in-class activity. The details about each of the four deliverables are described below.

Table 1: Assignment deliverables, submission type, and timing of due date.

Deliverables	Submission By	Due Date
1. Your team's opening statement. Each team member must deliver part of the opening statement, and your document should clearly show who is responsible for reading which part of the statement.	Team	Before In-class Activity
2. A document outlining the additional research your group conducted in preparing for the meeting. The document must include references for all of the resources you used.	Team	Before In-class Activity
3. Active and engaged participation in the simulated stakeholder meeting.	Individual	During Class
4. Reflection Questions	Individual	After In-class Activity

Deliverable 1: Preparing an Opening Statement

The assignment document explained to students that at the beginning of the meeting each team would provide a three-minute opening statement outlining their stakeholder group's interests, priorities, and goals. Further, each student on the team was required to read at least part of the opening statement. Additionally, this would be their opportunity to identify where they would like to place the wind farm in the ocean special management area boundary designated by the RI SAMP [14]. A gridded version of the map would be used in the meeting so that teams could specify exact coordinates, similar to the approach in the game Battleship.

To prepare for the simulated meeting, including writing their opening statement, each group was given a unique dossier of background information pertaining specifically to their stakeholders' interests. The content of each dossier is outlined in Table 2 below, by chapter and page of the RI SAMP. Note that there is minimal overlap in the information provided to each unique stakeholder group. The students were given the citation of the RI SAMP, such that they could

seek out the document to further their background research if desired. Though in practice, few if any students took advantage of that opportunity.

Table 2: The unique contents of each stakeholder groups' dossiers, as excerpted from the RI SAMP, Volume I.

Stakeholder Group	Contents of Dossier from RI SAMP
All groups	Chapter 1, Page 10.
Public Pro Wind Farm	Chapter 8, Pages 8-23
Public Anti Wind Farm	Chapter 2, Pages 65, 89-95, 103 Chapter 4, Pages 3-21, 49
Commercial Fisheries	Chapter 5, Pages 9-16, 70-71, 80-84, 88, 100-101, 106-108, 113
Recreation and Tourism	Chapter 5, Page 132 Chapter 6, Pages 4-10, 16-17, 19-20, 26, 29, 36, 38, 40
Transportation Regulators	Chapter 7, Pages 5-12, 17, 27, 28, 33, 48 Chapter 8, Page 231
Developers and Engineers	Chapter 2, Pages 7, 15, 29, 39 Chapter 8, Pages 8-21, 32, 58, 61-6

Each team was required to submit a digital copy of their opening statement to the course's learning management system before the start of the simulated meeting. Students brought physical copies of their opening statements to class, to read from at the start of the meeting.

Deliverable 2: Additional Background Research

Additionally, groups were tasked with performing supplemental research to expand upon the information provided in the dossiers. Each group was required to submit a document outlining their additional research, including all references. Earlier in the semester students completed an assignment where they read multiple articles about climate change, selected by their instructor, and assessed the credibility of each source. This earlier assignment was designed to prepare students to consider the credibility of their sources for their background research in this activity. Students were encouraged to perform ample additional research ahead of the simulated meeting.

Deliverable 3: Participation during In-class Activity

The third deliverable was tied to the students' active and engaged participation during the in-class activity. Each team member was required to speak during their stakeholder group's opening statement. Further, the students were instructed that the remainder of the meeting would be used for negotiations, with the goal of selecting a mutually agreeable location for the offshore wind farm. Students' grades for this deliverable were based on the quality of the delivery of their opening statement and participation in the negotiation phase of the meeting – looking for demonstrations of knowledge, skill, and engaged participation.

Deliverable 4: Post-activity Reflection

The final deliverable was to be completed after the in-class activity, as a reflection on the meeting outcomes, assessment of their own performance, and gained skills and knowledge.

Students were asked to respond to the five questions below and submit their written responses to the course's learning management system:

1) *From the perspective of your stakeholder group, were you pleased with the outcome of the meeting? Why or why not?*
2) *What skills did you gain from participating in the simulated stakeholders meeting? Be specific and cite examples.*
3) *What knowledge did you gain from participating in the simulated stakeholders meeting? Be specific and cite examples.*
4) *If you could redo the in-class exercise, what would you do differently? Why?*
5) *This was a team-based assignment and activity. What were your main contributions to the work? What did your team members contribute? Was the work evenly distributed?*

The Simulated Stakeholder Meeting

The stakeholder meeting was held during a single 50-minute class period using the agenda provided in Figure 2. Each team was given three minutes to read their opening statements, in the order listed at the bottom of the agenda. Following the opening statements, teams met privately for five minutes to discuss reactions, rebuttals, concessions, and/or counter arguments. Next, rebuttals and counter offers were delivered, this time in reverse order from the opening statements. As the class session neared its end, the groups were encouraged to come to a final agreement on the location for the next offshore wind farm.

Stakeholder Meeting
Offshore Wind Farm for Rhode Island
Date

Action Items
1. Select location for offshore wind farm (twenty 12 MW turbines)
2. Determine layout of wind farm

Agenda

11:00am	Opening statements from each stakeholder group
11:15am	Private stakeholder meetings
11:20am	Rebuttals and counter offers
11:40am	Develop agreement terms
11:45am	Meeting closure

In Attendance

Stakeholder Group	Team Members
Public: Pro Wind Farm	Student Names
Public: Anti Wind Farm	Student Names
Commercial Fisheries	Student Names
Recreation and Tourism	Student Names
Transportation Regulators	Student Names
Developers/Engineers	Student Names

Figure 2: The simulated stakeholder meeting agenda.

The concerns, goals, and priorities of each stakeholder group are summarized here, with the aim of illustrating one way in which this role-playing activity can unfold. It recognizes that each individual brings their own lens when performing background research. Moreover, each team comes together differently when determining the unique priorities of their stakeholder group. Each year, the simulated meeting progresses in different ways, beginning with distinctive opening statements and goals. The following summaries pertain to what students presented in the fall of 2022 and may omit concerns, goals, or priorities that students from other years have highlighted (or true stakeholders might deem important).

The students representing the Public Pro-Wind Farm group promoted the need for efficient, environmentally friendly, and inexpensive sources of electricity for the state of Rhode Island. Moreover, they highlighted the negative impacts of fossil fuels and natural gases as contributors to climate change and air pollution. Their initial site selection was driven by the desire to place the turbines in an area with strong wind speeds to maximize power production. Further, they wanted a location that balanced being far from shore to minimize visual impacts that might cause backlash from some members of the public, yet still lie within state waters to avoid the need for federal permitting, and lastly not too distant to make maintenance difficult. Finally, their ideal location should avoid popular shipping routes in Narragansett Bay and the environs. With those concerns and aims in mind, the Public Pro-Wind Farm group proposed locating the farm in cell B5.

On the other end of the spectrum, the students role-playing the Public Anti-Wind Farm group laid out a case focused on preserving the historical, cultural, and environmental resources of the region. This group pleaded that development of an offshore wind farm would have negative impacts cultural and historical assets such as shipwreck sites, pre-contact tribal landscapes, and archeological sites. Moreover, they shared concerns about disrupting sea life, including the migration patterns of whales and birds. Finally, the group argued that the wind farm would need to be decommissioned after 20-25 years, and while the steel from the towers could largely be recycled, the fiberglass from the blades would probably be sent to landfills. This group did not propose a site for the wind farm.

The Commercial Fisheries stakeholder group also shared concerns about the impacts on wildlife, countered by excitement about potential benefits. On their list of worries were the impacts on mammals, the potentially negative effects on biodiversity of native species, and open access to fishing areas during the construction phase. On the flip side, they also recognized the potential benefits of the wind farm in promoting the development of ecosystems post-installation due to mussel and algae growth on the support structures. The main priorities of this stakeholder group, however, were aligned with the economics of the state's fishing industry. Their goals in selecting a location for the wind farm focused on not blocking ports, ensuring continuation of existing shipping routes, and allowing fishing to continue wherever the farm is installed. Because of these drivers, the Commercial Fisheries group proposed cells C5 to C7, or D5 to D7, for the wind farm.

Another group heavily focused on economic drivers was the Recreation and Tourism group. Students on this team acknowledged the great importance of this industry's economic impact on the state, making the case that the wind farm location should minimally impact such activities as

surfing, fishing, diving, sailing, whale watching, etc. Further, they hoped the installed wind farm would be installed far from shore to preserve the beauty of the coastline. The goals and interests of the Recreation and Tourism industry led the students to propose the bottom halves of cells D2 and E2, or D6 and D7.

The students role-playing the Transportation Regulators argued that the safety of the public and the environment was paramount, while also stating the need to minimize disruptions to current routine use of the area. This group examined ship and boat traffic in the Rhode Island Sound – the area connecting Narragansett Bay, Long Island Sound, and Buzzards Bay – to identify the areas with the least activity. Additionally, they hoped to avoid areas with military test sites and any existing underwater cables. Those concerns, along with a desire to place the farm in an area of high wind resource, led this group to propose cell D3 for the wind farm's location.

Finally, the Developers and Engineers group shared their desire to select a location with strong, consistent winds to maximize power production, and a flat seafloor for ease of tower installation. The students shared that it would be an added bonus to locate the farm far from shore, thus minimizing a visual impacts to which some members of the public might object. On a more positive note, the Developers and Engineers argued that the fisheries would benefit from the wind farm, as it would create habitats for sea life, thus promoting breeding and increasing fish populations. Finally, they noted that the wind farm would mitigate environmental impacts of other power production sources. Their arguments came together to results in a proposed location in cell C6.

The preliminary site proposals from each stakeholder group are shown in Figure 3 on the map taken from the RI SAMP and drawn on by students during the simulated meeting.

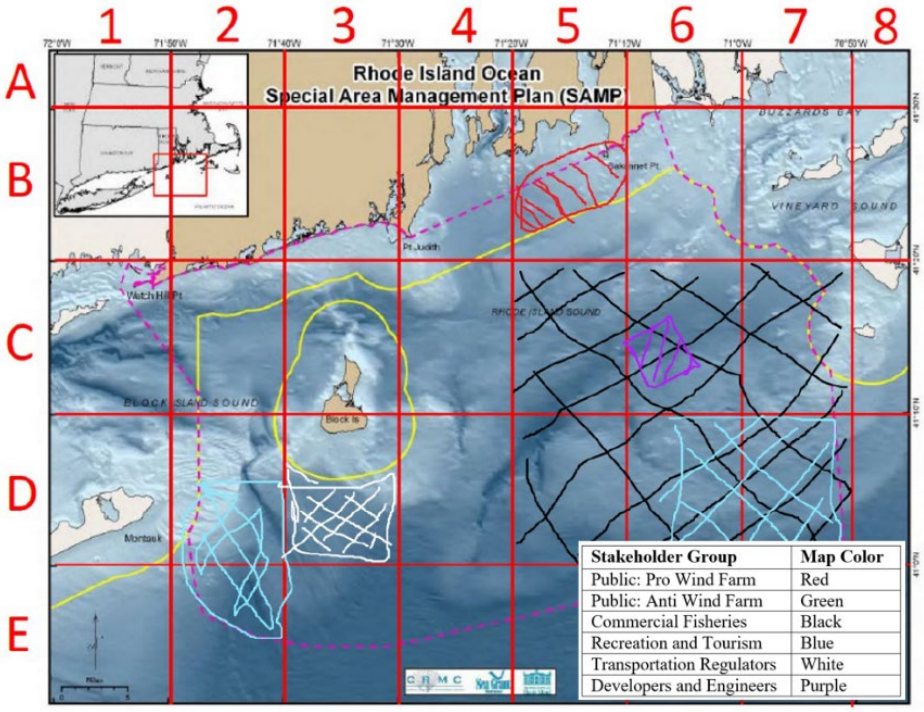

Figure 3: Preliminary site proposals from each of the stakeholder groups.

Following the opening statements and preliminary site proposals, teams were given five minutes to convene to plans any rebuttals, counter-proposals, and/or concessions. Going in reverse order from the opening statements, the Developers and Engineers gave the first response. This process proceeded until a revised site proposal map was created, shown in Figure 4.

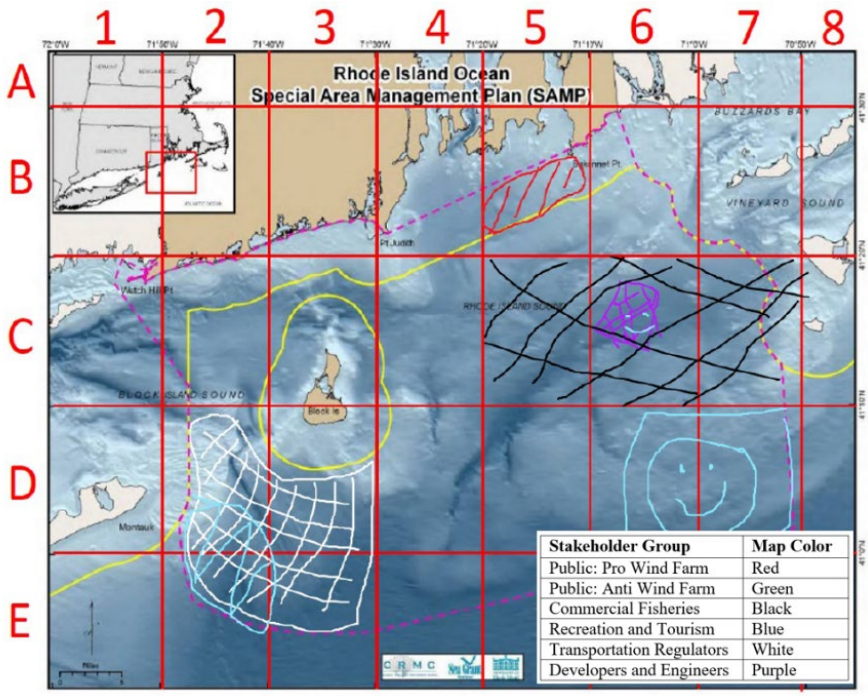

Figure 4: Revised site proposals, following rebuttals and counter offers from each group.

Finally, each team met privately for a final time to discuss the latest round of proposals. The final site proposals from each stakeholder group were listed on the board. Each team was given the opportunity to vote yes or no to each of the proposed sites. The summary of the votes are provided in Table 3. The winning location, with four yes votes, was cell C6. (Note that the Revolution Wind project is being planned for installation in cell C6 [15], while the location of the existing Block Island Wind Farm is the middle of Cell D3.)

Table 3: Final site proposals and voting results. Three groups came together to propose the same final site. The stakeholders then agreed, by vote, to locate the proposed wind farm in cell C6.

Stakeholder Group(s)	Final Site Proposal	Yes	No
Public: Anti Wind Farm (PA)	None	1: PA	5: CF, D&E, PP, R&T, TR
Public: Pro Wind Farm (PP)	B5	2: D&E, PP	4: PA, R&T, CF, TR
Transportation Regulators (TR)	E2-3	3: CF, R&T, TR	3: D&E, PA, PP
Commercial Fisheries (CF), Recreation and Tourism (R&T), Developers and Engineers (D&E)	C6	4: D&E, CF, PP, R&T	2: PA, TR

In the final reflection exercise students were asked, "*From the perspective of your stakeholder group, were you pleased with the outcome of the meeting? Why or why not?"* Three of the groups had uniformly positive responses, including the Commercial Fisheries, Developers & Engineers, and Recreation & Tourism stakeholders. This result is perhaps not surprising given that these were the teams that proposed the winning location. Two of the three students on the Public Pro-Wind Farm team were pleased with the final outcome, while only one member of the Public Anti-Wind Farm and Transportation Regulators teams were happy. This split amongst team members is indicative of the complicated nature of these exercises, which reflects the real world. Though individuals can come together to share large picture concerns and goals, their personal reaction to final outcomes is not always uniform.

Table 4: Responses to the prompt "*From the perspective of your stakeholder group, were you pleased with the outcome of the meeting?"*

	% of "Yes" Responses
Commercial Fisheries	100
Developers & Engineers	100
Recreation & Tourism	100
Public Pro-Wind Farm	66
Public Anti-Wind Farm	33
Transportation Regulators	33

Impacts on Student Learning

The original driver in creating this role-playing exercise was the need to provide an engaging, sincere, and effective means of enhancing the students' appreciation for engineering ethics. As an added benefit, the pedagogy has been shown to deepen other skills and knowledge as well. To assess students' growth in all these areas, their written responses to a post-activity set of reflection questions, described in Deliverable 4 earlier in this work, were explored and organized thematically.

Students' responses to the prompt, *"What skills did you gain from participating in the simulated stakeholders meeting? Be specific and cite examples"* largely fell into three categories – gains in communication skills, appreciation of the subtleties of negotiations, and growth in conducting background research. Quotes from student work, as shown below, indicate a range of communication skills that were strengthened by participating in the simulated stakeholder meeting. One student focused on relaying information to larger audiences, while also needing to consider multiple viewpoints. A second student felt they improved their ability to share their needs and priorities. Finally, another student commented on the importance of communicating on a short time scale with their teammates.

> I definitely gained important skills during the stakeholder meeting; how to effectively present information to a larger audience, how to conduct myself in round-table style meetings, and I sharpened my ability to appeal to both sides of an argument.

> Doing this simulated stakeholder meeting I improved my communication skills by describing what I wanted out of [the] meeting.
>
> Throughout this simulated stakeholder meeting, I learned how to have quick and effective communication with my group members to form rebuttal statements.

Under the same umbrella of communication, students delved deeper to consider strategies that were and were not effective in negotiating successfully. On a positive note, student pointed out that commonalities between stakeholders were effective in moving negotiations forward. Meanwhile another student highlighted the negative repercussions of anger and aggression that can cause negotiations to stall. These socioemotional findings from students are compelling, especially because these skills and ideas are rarely discussed in a traditional engineering curriculum.

> Something I learned from the meeting was the importance of finding common ground with other groups. Being able to find common ground gives you more bargaining power with them and allows you to more easily negotiate with them.
>
> I learned the importance of kindness and courtesy within a negotiation because coming off aggressive or angry makes other groups less likely to change their opinion. For example with the pro-wind group and some angry comments from [another student] in my group. From there it was difficult to gain their trust and get them on our side.

Aside from communication skills, students noted gains in their research skills. In the statement below, a student discusses methods for assessing the credibility of their sources. This topic was briefly covered in an earlier homework assignment and this response indicates that learning outcome was achieved.

> Proper research etiquette, where cross referencing articles or avoiding biased articles were key to getting accurate information. If there was a question of validity, it was important to find multiple articles either confirming or denying a question.

Next, responses to the prompt, *"What knowledge did you gain from participating in the simulated stakeholders meeting? Be specific and cite examples"* were explored and organized by theme. Students self-reported gained knowledge fell into two main categories; concrete facts about the ocean special management area and an appreciation for the complexities of installing engineering projects. In the excerpt below, students share specific examples that they learned from reading their dossiers and completing their own supplemental research.

> I gained loads of knowledge from this meeting, regarding shipping routes, commercial fishing zones, and also that ocean floor bottom types may influence the build location.
>
> I was opened to the actual scope of what goes on in the ocean; the military testing, boat races, tourism areas, the commercial fisheries, trade routes, ideal areas of wind patterns/speeds, distinct marine life areas. Overall, lots more to consider than what I had originally thought.

The second quote provided above begins to demonstrate an appreciation for the challenges and complexities of engineering projects, beyond just the technical details. The student quotes

included below further drive home that point. One student specifically pointed to the effort involved in selecting a site, noting that in a single class session we only began to uncover the multitude of challenges involved in this situation. A second student highlighted this piece of their learning by sharing their original misconception that this would be an easy task, when it was anything but.

> Some knowledge I gained from the meeting was how much effort it takes to come to a decision on the placement of this wind farm. We barely scratched the surface as a class since we were confined to fifty minutes. In reality there are so many moving parts including the public, money, time, etc.
>
> Something that seems a very easy decision (supporting wind farms), can become complicated really quick. I never realized how many different stakeholder groups there are.

Finally, students responded to the questions, *"If you could redo the in-class exercise, what would you do differently? Why?"* Many students pointed to wanting to prepare more effectively for the exercise, while others were more focused on honing their negotiation strategies, in many cases pointing to socioemotional factors yet again.

Multiple students shared the desired to complete more research before the role-playing activity. In all of these cases, the students were focused on learning more about the other groups' priorities and goals, perhaps suggesting that the research about their own group was more than sufficient. These reflections by the students will be taken into account when considering improvements to the activity in future years, as it would strengthen their learning to understand the perspectives of others as they head into the simulated meeting.

> I would like [to] be able to do more cross research. Going into other groups' provided maps and maybe understanding more of where they can/can't go to help develop more argumentative/persuasive propositions.
>
> I would look into what other peoples [sic] priorities are prior to the meeting to help get a better understanding of what they need to be satisfied with the outcome and what would make a successful meeting for them.

One of the students went on to say that they were not aware that each group's dossier was unique, which raises the need for instruction to be more transparent in future years. On a more constructive note, this student's suggestion to split the exercise over two class periods is well taken. Fitting the role-playing exercise into a 50-minute period felt tight. The student's specific recommendation of how to divide the activity over two class meetings is well considered and will likely be adopted in the future.

> If I had the opportunity to redo the in-class exercise, I would separate it into two lessons. The first lesson would be the initial meeting where the stakeholder groups were only provided with specific charts and information pertaining to their group. Before the second lesson, each stakeholder group would have access to all the charts and graphs. Personally, I did not know that the other stakeholder groups had different graphs and charts than the engineers and developers had. I believe this would help other groups make an accurate decision and result in less argument about a location.

Meanwhile, other students focused on ways in which they would improve their negotiation strategies. One student considered thinking about their argument from a different angle and sharing why certain sites would not work, instead of focusing on just the favorable locations. Another student wished they could revisit the rebuttal stage of the meeting, in particular pointing to negative emotional reactions from other groups.

> If we were to do this over, I think that we would explain why the sites we did not select cannot be used for the windmill farm. We explained why the sites we picked worked, but we did not do a good job in explaining why we didn't pick the other sites.

> If I were able to redo the class exercise, I would have changed the way I approached the rebuttal phase. […] By trying to go after each groups [sic] position instead of defending our own, I believe that I created resentment from other stakeholders that immobilized our efforts.

Again, socioemotional factors appeared in students' reflections. Some students shared concerns they had with their partners' behaviors, while others took more personal responsibility for growing angry during the meeting. These responses are interesting because it is rare for students grapple with their emotions in most engineering classes and activities. Moreover, these reflections suggest that students engaged with the material on a deep level; that the role-playing activity was therefore experiential in nature, unlike other activities that may come across as abstractions from reality.

> I think if we were able to redo the meeting I would like to be able to better control one of my group members. Some comments were made that may have rubbed some of the other groups the wrong way.

> Probably try not to get mad quickly when another stakeholder group is judging our statement. Because the madder I got, more I couldn't kept my thoughts together to present a better counterexample.

The skills and knowledge that students cited in their reflections will serve them well as they approach the start of their professional careers in engineering. These reflections are also compelling because many contained comments about socioemotional factors, suggesting that students engaged seriously and deeply with the work, truly taking on the wants, needs, and desires of their assigned stakeholder group.

Conclusions and Recommendations for the Future

An assignment and corresponding in-class activity, motivated by the need to provide engaging and meaningful ethics education to engineering undergraduates, was recently developed and implemented for an upper level elective course in ocean engineering. To overcome challenges often associated with ethics lessons, including abstraction and boredom, a role-playing pedagogy was adopted in which students participated in a simulated stakeholder meeting with the goal of selecting a new location for an offshore wind farm in New England. This paper presents the framework of the assignment and exercise, alongside an exploration of student reflections that highlights various impacts on their learning. The goal of introducing an engaging and effective lesson on engineering ethics was met, as indicated by the students' responses about their growth in skills, knowledge, and deep connection with the role-playing exercise.

While the assignment and activity were successful, there is still room for future improvement. One of the main challenges of the role-playing activity is the timing. This course was taught in a 50-minute block which was too constricting. In the future, the simulated stakeholder meeting should be split across two lesson periods to allow sufficient time for the students to engage deeply in the material.

More specifically, students were told to limit their opening statements to three minutes, but many groups went over their allotted time. It may be helpful to either give the students a suggested word count to constrain their time or to instead extend their time for reading the opening statements. The rebuttal phase of the meeting was restricted to a single round, though it is likely that the stakeholder groups would have liked a second or even third round of rebuttals before sending the final proposals to a vote. Finally, there was not enough time at the end of class to debrief the activity. At the very least it would be nice to share the real-world outcomes as compared to the class's solution – that is, revealing the location of the Block Island Wind Farm is in D3, while their selected site in cell C6 matches the proposed location for the new Revolution Wind Farm [15].

One student, as quoted earlier in the paper, provided very specific and astute suggestions for how the activity might be split across two class periods. The student suggested to use the first lesson as an initial meeting – very similarly to what happened in our single simulated meeting – with groups performing background research on their own stakeholder group's dossiers. Then, in a second class meeting, students would arrive prepared for rebuttals, having used the time away from class to research the other stakeholders' viewpoints.

On the topic of investigating other stakeholders' positions, there is room for improvement in guiding students' background research. Many students relied heavily on academic journal articles but would perhaps benefit from also exploring the mass media. Local news coverage, in particular, paints a strong picture of the viewpoints of stakeholders while also providing more up-to-date information than an academic journal.

The simulated stakeholder meeting will continue to be implemented in this course for the foreseeable future, including updates based on the suggestions outlined above. The role-playing activity and assignment were effective in deepening students' engagement with issues of engineering ethics. While the topic of an offshore wind farm was pertinent to the location of our university, the exercise could be adapted to highlight the issues relevant to any region.

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