

AC 2010-1478: U.S. COAST GUARD ACADEMY RENEWABLE OCEAN ENERGY SEMINAR

Elizabeth Garcia, Miami Dade College

Jonathan Andrechik, U.S. Coast Guard

U.S. Coast Guard Academy Renewable Ocean Energy Seminar

Abstract

In the spring 2009 semester at the U.S. Coast Guard Academy, one science instructor and one engineering instructor co-taught a one-credit independent study course entitled Renewable Ocean Energy Seminar. Fifteen engineering majors and fourteen non-engineering majors enrolled in this elective course. The intention was to bring together different majors to learn about the many facets of renewable ocean energy (policy, technology, economics, etc.) and to develop cross-discipline communication. In the end, nine seminars were presented, seven of which were presented by instructors of different academic disciplines from within the U.S. Coast Guard Academy. The other two seminars were presented by individuals accepting invitation to discuss work being done outside the Academy. One of speakers came from the U.S. Coast Guard Headquarters, and the other from an out-of-state center for ocean energy technology. The remaining lectures were focused on the students working together and educating each other. Assignments included two relevant current event reviews, two relevant website evaluations, all presented to the class, and a final memorandum addressed to the U.S. Coast Guard Headquarters, outlining each student's opinion on the role of the U.S. Coast Guard in renewable ocean energy, using research to support their view.

In the end-of-course evaluation, 100% of the students responded positively to the statement "This seminar improved my understanding of the issues surrounding ocean energy." They all also responded positively to the statement "I enjoyed taking this course." 86% of the students responded positively to the statement "I can apply the material presented in this course to real life situations." This paper outlines the student feedback on the overall course as well as the instructors' observations, while outlining the structure of the course, along with the successes and lessons learned. Overall, the Renewable Ocean Energy Seminar is evaluated as a success in its first offering.

Course Structure

The Renewable Ocean Energy Seminar was a one-credit course that met once a week for the entire length of the Spring 2009 semester. This was an elective course offered in addition to the required courses of the U.S. Coast Guard Academy. The course started with thirty-one students. Two students dropped the course before the end of the semester, resulting in twenty-nine students completing the course. During the first class meeting, students were given a syllabus, outlining the course and the grading structure. The course was web-enhanced with the use of Blackboard, where assignments were submitted for sharing amongst all students, and references to additional information sources on renewable ocean energy, as well as many of the seminar presentations, were posted.

The syllabus provided the following course description:

This is a cross-disciplinary, 1-credit seminar course being offered for the first time this Spring 2009. The key focus is on renewable ocean energy and its many tie-ins to the various U.S. Coast

Guard Academy majors. Cross-disciplinary communication will be encouraged, while various questions will be investigated, such as:

- *What types of and how much energy is available in the oceans?*
- *Who is responsible for overseeing the design and functioning of ocean energy installations?*
- *What is the cost analysis of ocean energy versus traditional energy sources, particularly fossil fuels?*
- *What are the various applications of ocean energy?*
- *What are the implications of ocean energy on navigation and national security?*
- *Should ocean energy be pursued?*

The course will include various presentations followed by in class discussion.

The primary goals of the course were to foster students' cross-disciplinary communication skills and promote an understanding of current energy issues in the setting of renewable ocean energy. By the end of the course, the students were to have achieved the following objectives listed in the course syllabus:

1. *List and discuss the viability of various ocean energy sources.*
2. *Identify national regulators of ocean energy policy.*
3. *Identify the costs of various ocean energy sources and compare to traditional energy costs.*
4. *Show familiarity with existing ocean energy technologies.*
5. *Demonstrate awareness of navigational and security issues linked to ocean energy installations.*
6. *Argue for or against the further development of renewable ocean energy.*
7. *Communicate in terms that all majors (engineering, science, operations research, management, and government) can understand.*

The prerequisite to enroll in the course was that students were to be in their second year of studies or higher at the U.S. Coast Guard Academy in any major.

The final grade was determined as follows: 20% for class participation, 40% for homework, and 40% for the final written paper. The grading rubric is shown below in Table 1. The rubric proved to be a useful tool in evaluating student performance, where final grades ranged from H to B, and follows the recommendation of McKeachie and Svincki² for grading written assignments.

Students were provided guidance in the syllabus about respectful class discussion techniques as well as homework formatting and plagiarism. There were two types of assignments in the class. One was a relevant current event review, and the other was a relevant webpage evaluation. The instructors chose these types of assignments to encourage students to discover, consider, and evaluate the credibility of a large amount of information readily available to them over the internet on the topic of renewable ocean energy. Additionally, these assignments afforded the students an opportunity to choose current events and websites they found particularly interesting, while at the same time providing some convenience in locating and completing the assignments given that most students were taking this course as an overload in semester credit hours.

Table 1: Renewable Ocean Energy Seminar Grading Rubric.

Grade	Class Participation	Homework	Final Paper
H	Consistently participates and is respectful of others.	Above and beyond requirements.	Above and beyond requirements.
A	Regularly contributes to discussions.	Satisfactorily completes assignment in a timely fashion.	Satisfactorily completes paper.
B	Contributes, but irregularly.	Assignments not thorough.	Not completely satisfactory.
C	Inconsistent participation.	Sloppy and not thorough.	Sloppy and not complete.
D	Does not contribute.	Very weak attempt.	Very weak attempt.
F	Does not contribute to discussions and interrupts classmates.	None.	None.

Students had to submit one of each type before midterm and one of each type after midterm, for a total of four homework assignments. Samples of the required format were provided in the syllabus and posted online in Blackboard. Students were then asked to summarize their current event reviews and webpage evaluations for the entire class during class discussion times.

The final assignment for the course required each student to write a memorandum to the U.S. Coast Guard Headquarters, outlining the student’s thoughts on the role of the U.S. Coast Guard in renewable ocean energy. Students had to include references in the memorandum to demonstrate that their opinions were well researched. The instructors chose this idea for the “final exam” as it provided a concise mechanism to assess student learning while underscoring the relevance of the topic to the U.S. Coast Guard.

The course met fourteen times over the course of the semester. Four classes were dedicated to discussions, and the first class was an overview of renewable ocean energy. The other nine lecture periods were occupied by seminar presentations, seven from faculty at the U.S. Coast Guard Academy, and two from visitors who accepted invitations to present to the students. The seminar topics, in order by date presented, are outlined in Table 2, and the background of the presenter is given in the second column.

Student Course Feedback

With 29 students in the course, at least one student was enrolled from each of the eight majors offered at the U.S. Coast Guard Academy, as shown in Figure 1 (3% ≈ 1 student). Female students were underrepresented in the course as shown in Figure 2. It is difficult to speculate as to the reason for this. It can be noted, as well, that one of the instructors was a female engineering faculty member and the second instructor was a male science faculty member.

Table 2: Renewable Ocean Energy Seminar Topics.

Topic	Presenter Background
Ocean Energy Sources	U.S. Coast Guard Academy faculty, Science
A First-Order Approximation of Available Tidal Power off of Race Point	Two U.S. Coast Guard Academy faculty, Engineering
U.S. Coast Guard on Offshore Renewable Energy Installations	U.S. Coast Guard employee
Out-of-State Center for Ocean Energy Technology	Out-of-State Center employee
Wind Turbines & Floating Platforms	U.S. Coast Guard Academy faculty, Engineering
Renewable Electricity System Components	U.S. Coast Guard Academy faculty and student, Engineering
Electricity Portfolio & Cost Optimization	U.S. Coast Guard Academy faculty, Mathematics
Social History of Climate Change	U.S. Coast Guard Academy faculty, Humanities
Business of Ocean Energy	U.S. Coast Guard Academy faculty, Management

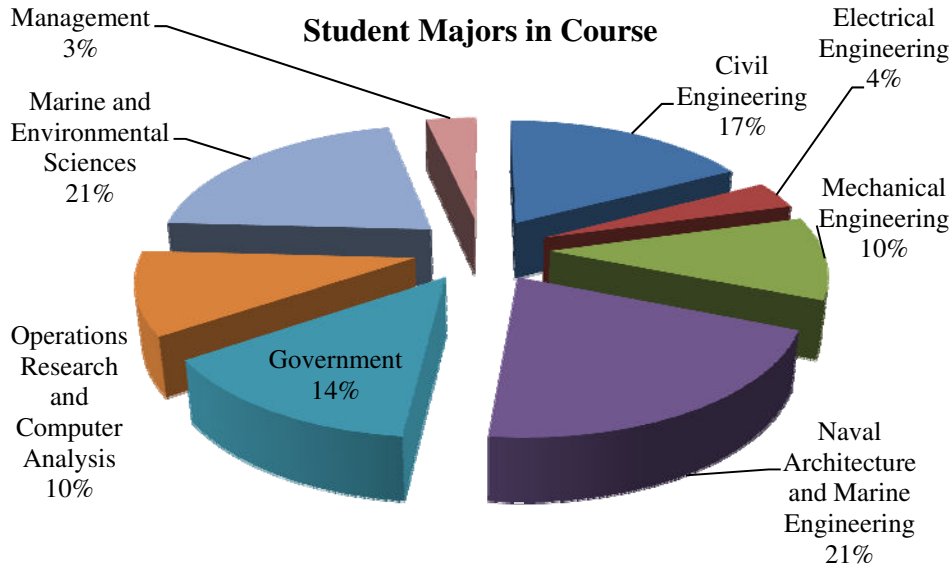


Figure 1: Declared Majors of the 29 Students Enrolled in the Renewable Ocean Energy Seminar Course.

On the last day of the class, students were asked to complete a sixty-three question end of course survey, where the only identifying information was their major and their gender. Room for comments and suggestions was provided, and most students took the opportunity to write several lines of comments.

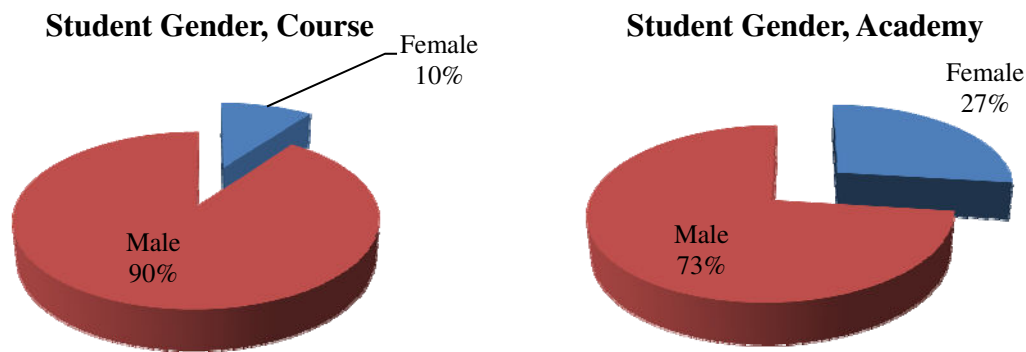


Figure 2: Percentage of Female and Male Students within Renewable Ocean Energy Seminar Course compared with the U.S. Coast Guard Academy Student Body.³

The types of questions asked can be broken into six categories: (1) overall impression of the course, (2) the instructors, (3) the presentations, (4) the students' self-assessment of topic competency, (5) the overall understanding of renewable ocean energy, and (6) the research tools used by students. In the interest of space and time, only those comments that demonstrate the overall course strengths and weaknesses are presented in Table 3.

While Table 3 shows a substantial number of positive responses, there are several points that need further emphasis or improvement. In particular, students did not find the library useful in the course despite the fact that they were asked to do research both for the current event review homework as well as for the final paper memorandum. An introduction to peer-reviewed research papers within the library and mandating the use of these materials in the course could rectify this.

In addition, less than half the class found the course useful in improving communication between majors – a major objective of the course. The classroom had stadium seating, and was selected for the seminar presentations during the course. However, this proved to be an obstacle in encouraging conversation. One solution provided in the comment of a student on the feedback form was to move to another classroom for discussions where the students could sit in circles to facilitate communication. This is definitely a worthwhile suggestion. While quite a bit of student discussion occurred during the course, perhaps the objective of improving communication between majors would have been more satisfactorily met by requiring students of different majors to collaborate on assignments, both inside and outside of the classroom. Much of the individual assessment of student learning in this course was based on individual effort – not group effort. One student suggested at the end of the course that the final assignment of writing a memorandum on the feasibility of renewable ocean energy use in the U.S. Coast Guard would be improved if it were instead a collaborative effort between small groups of students. This, too, is a worthwhile suggestion, so long as the collaboration would promote greater understanding and improved communication between students of different majors.

Table 3: Summary of End of Course Survey Student Feedback by percentage for 29 out of 63 survey questions for the 29 students in the course. Positive percentages represent the sum of Strongly Agree and Agree. Negative percentages represent the sum of Disagree and Strongly Disagree.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable	(Positive)	(Negative)
1.	I enjoyed taking this course.	28%	69%	3%	0%	0%	0%	97%	0%
13.	I'd be interested in a design project based on ocean energy.	38	45	3	10	3	0	83	14
20.	This seminar improved my understanding of issues surrounding ocean energy.	48	52	0	0	0	0	100	0
27.	The instructors were encouraging of students.	48	41	10	0	0	0	90	0
29.	The instructors had competency in the subject of ocean energy.	41	59	0	0	0	0	100	0
40.	I believe this course will benefit me during my career.	34	59	7	0	0	0	93	0
45.	I researched the issues discussed in class on my own after presentations/discussions.	3	69	10	17	0	0	72	17
49.	My ability to communicate with students from other majors has improved because of this course.	17	31	28	24	0	0	48	24
55.	I recognize the need to engage in life-long learning to stay current in ocean energy issues.	31	59	10	0	0	0	90	0
59.	This course allowed me to demonstrate creativity in thinking.	34	48	17	0	0	0	83	0
60.	This course integrated many subjects well.	31	62	3	3	0	0	93	3
61.	I found the library useful in success in this course.	7	0	28	24	24	17	7	48
62.	I found the internet useful in success in this course.	76	24	0	0	0	0	100	0

Among the nine seminars listed in Table 2, the most popular were Ocean Energy Sources, with 97% positive ratings (Strongly Agree and Agree combined) and A First-Order Approximation of Available Tidal Power off of Race Point, with 90% positive ratings. In the Ocean Energy Sources seminar, ocean energy was outlined on the spectrum of kinetic and potential energy sources, and the abundance of those energy sources with reference to geographic dependence

was discussed. This seminar served as the background information for the students for the rest of the course, and obviously proved useful from the student perspective.

The seminar on the approximation of tidal power was an interactive seminar, where students were given flow speed and bathymetry data for the region of interest, along with the units of energy, and the students had to determine how best to estimate the total energy. This interactive approach proved popular, and the fact that the students worked in groups to do calculations was perceived as positive even by a number of non-engineering majors.

The seminars with the largest negative ratings (Disagree and Strongly Disagree combined) were the Social History of Climate Change, with 17% negative responses, and a tie between Electricity Portfolio & Cost Optimization and Out-of-State Center for Ocean Energy Technology, both with 10% negative responses. This is not an overwhelming negative response, and there were still far more positive responses than negative ones. It is the assessment of the instructors that the presentations were useful, particularly to bring in additional perspectives on the topic of ocean energy. The electricity portfolio brought in the perspective of a math faculty who had worked in the electricity industry. The climate change seminar was presented by a humanities faculty, integrating a non-technical perspective, and the ocean energy technology seminar brought in an employee working in ocean energy research who had recently completed their engineering undergraduate degree less than two years prior.

Every student took the time to write additional comments and suggestions on the course. Those that seemed to be repeated by multiple students are outlined here. The most popular suggestion was to have at least one field trip for the course during the semester to a company involved in renewable ocean energy. Many students enjoyed taking a class with all majors, with one student writing “I enjoyed the integration of different majors.” One response that came from several of the engineering majors was to make the course more technical with more calculations. This may have not been received well by other majors, but can easily be incorporated, particularly in combination with the suggestion of another student to have the final paper be written in groups of interdisciplinary student teams. In this sense, more engineering and calculations could be required in the final paper.

Several students indicated a desire for more background knowledge beyond the introduction and first seminar. This could be done by providing the students with a course pack, or by incorporating several chapters of a textbook that covers renewable ocean energy, such as Boyle’s *Renewable Energy*¹. Students also requested more discussion and debate time, and less homework, with just one current event review and one website evaluation during the semester. However, overall, 90% of the students rated the course as having a reasonable workload.

Evaluation of Course Objectives

The students’ achievement of the seven course objectives listed on the syllabus and outlined in Course Structure section of the paper was evaluated by the instructors in the final paper written

paper. Each student wrote a three to four page memorandum, most of which were later forwarded to the U.S. Coast Guard Headquarters, outlining the viability of ocean energy sources (Objective 1), identifying the national regulators of ocean energy policy and the possible role of the U.S. Coast Guard within this capacity (Objective 2), and discussing one or more ocean energy technologies that would be the most likely to prove viable (Objective 4).

In terms of outlining the role of the U.S. Coast Guard in ocean energy, the cadets demonstrated awareness of national and security issues linked to ocean energy installations (Objective 5). Once the student had developed a background of information for the memorandum, they then had to argue for or against ocean energy (Objective 6). There were several students who did in fact argue against renewable ocean energy, stating that it was not yet viable due to engineering challenges, as well as citing the high cost of ocean energy in comparison to traditional energy costs (Objective 2).

As the students expected their memoranda to be forwarded to U.S. Coast Guard Headquarters, the language they used had to be that which was technical enough to relay the information, yet could still be understood by someone who may not be familiar with purely technical jargon. This requirement helped to achieve Objective 7.

By the evaluation of the instructors, only two of the 29 students failed to communicate the proper information to support their argument, or a failure to develop an argument at all. The other 27 students were successful, and some even convincing beyond the scope of the course. As all the students successfully completed the two current event reviews and two website evaluations, the final written paper was the determining factor in the grade. The 27 students who successfully argued their stance on renewable ocean energy in the U.S. Coast Guard received a final grade of H or A (see Table 1 for the grading rubric), while the other two who unsuccessfully completed the final paper received lower marks. This represents a 93% success rate in the achievement of the course objectives by the students.

Conclusion

Overall, the course was a success and the students demonstrated that they knew themselves to come away with as much knowledge of the current state of renewable ocean energy as the U.S. Coast Guard Headquarters presenter by the end of the course. 79% of student respondents said that they would take the course again if there were new presentations. 97% said they would recommend the course to students within their major, and 93% of students said they would recommend it to students in other majors.

The instructors were very pleased with most of the final papers, and had enough confidence in the information written to forward these memoranda to the U.S. Coast Guard Headquarters.

Bibliography

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