



Lessons in On-Campus and Distance Learning Delivery of an Introductory Naval Architecture Course

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Lessons in On-Campus and Distance Learning Delivery of an Introductory Naval Architecture Course to Engineering and Engineering Technology Undergraduate Students

Abstract

This paper describes the author's experiences in multi-mode (face-to-face and online) delivery of an introductory-level course on the topic of Naval Architecture geared towards an audience of engineering and engineering technology undergraduate students with no previous maritime background. The goal of this course is to expose talented undergraduate engineering students to the marine industry and to prepare those interested in pursuing a career in this field with an introductory understanding of the complex nature of designing and building ships and other marine vessels. This course was offered in spring 2013 and fall 2013 to a group of engineering and engineering technology students. The course was offered as a hybrid course with students enrolled both as on-campus and distance-learning students. The paper touches on experiences and feedback from the instructor and students related to lectures, labs, assignments, project-based learning and site-visits.

Introduction

Building the next generation workforce, industry leaders, engineers, scientists and educators in the area of naval and marine engineering is critical to maintain the global competitiveness of the U.S. defense and marine industry. The U.S. Navy and maritime industry have a growing need to educate and hire scientists and engineers who are highly skilled in their major disciplines, educated in systems engineering, program management, technology transfer, and cognizant of critical research and technologies. This new generation of engineers must be trained to meet the significant design, manufacturing, and acquisition challenges of the 21st century Navy Fleet in order to lower acquisition costs, shorten design cycles, enhance platform capability, and lead the Navy and industry workforce.

Workforce challenges abound for the Navy and marine industry. The National Shipbuilding Research Program conducted a study in 2009 to address a workforce shortage of engineers in the U.S. marine industry¹. The primary finding was that at all levels the demand exceeds the supply. Approximately 30% of the marine industry's engineering workforce will be eligible to retire by 2014. This corresponds to an immediate demand for over 6,400 engineers, scientists, and mathematicians, followed by steady annual demand of 2,300 and 3,800 engineers. The data indicated a range of engineering disciplines must be addressed by the incoming workforce to conduct the complex tasks of developing ship systems, designing and constructing ships (NSRP, 2009). On the supply side – of the 340 ABET-accredited engineering colleges and universities in the U.S., only 15 offer a traditional marine engineering and naval architecture undergraduate program, including the United States Naval Academy and the United States Coast Guard Academy, as well as maritime schools where graduates qualify for professional licenses to go to sea. These 15 schools supply no more than 400 undergraduate engineers per year, and they are sought by many other parts of the industry outside of the naval shipbuilding enterprise.² Therefore, it is in our nation's interest to encourage the best and brightest domestic engineering and engineering technology students to consider careers in the marine industry.

The Batten College of Engineering and Technology (BCET) at Old Dominion University (ODU) in Norfolk, Virginia is developing a multi-disciplinary marine engineering and technology undergraduate program to help meet naval and national workforce needs in the marine industry. ODU is uniquely positioned to support these goals due to its strategic location in the southeastern Virginia, home of the largest naval base and third largest volume port on the U.S. east coast. The region hosts the largest concentration of ship repair and maintenance industries in the U.S. This academic program is designed to attract bright students early, engage them in a multi-disciplinary, marine-related engineering and technology curriculum, provide project-based learning and internship experiences that are both exciting and relevant to ensure student retention, and produce highly employable graduates to the marine industry. One of the new courses developed under ODU's marine engineering and technology undergraduate program is an Introduction to Naval Architecture course. This course was offered in both the spring 2013 and the fall 2013 semesters to engineering and engineering technology students. The course was offered as a hybrid course with students enrolled both as on-campus and distance-learning students. This paper touches on experiences and feedback from the instructor and students related to lectures, labs, assignments, project-based learning and site-visits.

Course Curriculum

The objective of the Introduction to Naval Architecture course is to expose talented undergraduate engineering and engineering technology students to the marine industry and to prepare those interested in pursuing a career in this field with an introductory understanding of the complex nature of designing and building ships and other marine vessels. The intended audience for the course is a mixture of students pursuing undergraduate degrees in mechanical engineering, electrical engineering, civil engineering, modeling and simulation, and engineering technology. Many of these students have no previous knowledge of ship design or ship construction. The course development also needed to take into consideration those students taking the course in a distance learning capacity.

In the development of the course, it was important to include a mixture of various pedagogical methodologies for conveying the course material. This was done for several reasons – first, this approach appeals to a broad scope of students and studies have shown that varying the teaching methodologies is very effective in conveying the course material; second, since this is the first offering of the course, it was important for the instructor to evaluate the effectiveness of different methodologies; third, this approach would allow the instructor to integrate more “real-world” scenarios into the educational environment to prepare students for their professional careers. As a result, the developed course includes classroom lectures, hands-on labs and site visits, analytical problem-solving assignments, critical thinking, multi-media assignments and project-based learning.

As part of the course development process, a survey of available textbooks was conducted. The author reviewed these potential textbooks based on the following merits:

- Breadth of topics
- Depth of each topic
- Relevance to current technology / industry practice
- Number of worked examples

- Number of problems to be solved, relevance, and level of difficulty
- Textbook availability and cost.

Based on this survey, the author selected the naval architecture textbook by Robert Zubaly, *Applied Naval Architecture*³.

Classroom Teaching

The course development also needed to take into consideration those students taking the course in a distance learning capacity. ODU has taken great effort in offering many courses as distance learning courses and has seen a steady rise in enrollment of distance learning students over the past 5 years. The marine industry workforce development needs are not limited to the Hampton Roads area and ODU wants to appeal to as broad a student base as possible. Case in point, when this course was offered in spring 2013, 18 students took the course on ODU's campus in Norfolk, Virginia and five students took the course remotely, including one student located in rural Virginia and two students located in Washington State. When this course was offered in fall 2013, 23 students took the course, however only 6 students took the course in the classroom, and 17 students took the course remotely, including locations in rural Virginia and several states nation-wide. This additional requirement of distance learning on the course development presented some unique challenges.

The instructor based the lecture series so as to follow the outline in the course textbook, which allowed for one topic module was covered per week, for 15 weeks. For the most part, the modules were delivered in lecture-style via ODU's Teletechnet Center, which broadcasts the lectures live, and also allows students who are registered for the course to log in and watch the lecture after it has been recorded. Students watching the lecture live can interact with the instructor via a chat format, additionally several distance-learning sites offered two-way video. Each week the students had an assignment to complete for the topic module discussed. The majority of these assignments were analytically-based using chapter problems from the textbook. Other assignments are discussed below.

Out-of-Class Learning

Other learning methods were explored in this new course offering to assess the advantages and disadvantages in reaching a traditional and distance learning student audience. During the learning module on ship production, those students who could travel for a site visit to a shipyard were required to do so and then complete a post-visit essay assignment on their knowledge gained during the visit. Students who were unable to attend a shipyard tour were given a multi-media assignment. These students watched a series of videos regarding ship production technologies and methodologies and completed an essay assignment on their observations to assess their knowledge gained.

One learning module was dedicated to the naval architecture concepts of sailing. Students who could travel to a sailing facility (either at ODU's sailing team facility on campus or a sailing center nearest to their location) were required to do so to complete an introductory sailing lab and then complete a post-lab assignment assessing their knowledge gained. Students who were unable to attend a sailing lab were given a multi-media assignment on sailing and completed an assignment to assess their knowledge gained.

Project-Based Learning

Students were required to conduct an independent research project on a topic pertaining to naval architecture. The instructor gave several suggested topics to show the breadth of topics that could be selected. All students were required to submit their proposed topic and abstract to the instructor for approval. Students could also work in pairs or groups of 3, however the requirements (depth of research and length of paper) were increased accordingly. Students had the option of presenting in person to the class or creating a pre-recorded lecture on their topic. This gave them an opportunity to learn new software as a result.

Course Evaluation

Student response to the course was overwhelmingly positive. All students responded that the course increased their knowledge of ship design and construction and helped prepare them to pursue an engineering or engineering technology position in the marine industry. All students would recommend this course to their peers.

- 68% of students agree that the textbook is organized, clear and easy to understand.
- 94% of students agree that the lectures are clear, organized and easy to understand.
- All students agree that the labs, site visits, and online assignments were beneficial to the learning process.
- 80% of students agree that a ship tour in the first or second week would add great value to the course.
- All students agreed that the sailing lab was a great highlight to the course, and most students had never been sailing before.
- All students agreed that the shipyard tour and the ship production online assignment greatly expanded their knowledge of the marine industry and also opened up new job opportunities for them to pursue. As a result, several students applied to and received job offers from the shipyard.
- Only 63% of students agree that meeting once a week for 3 hours is sufficient to learn and understand the material. Other students felt a course schedule that meets twice a week would be more beneficial. The instructor also felt that meeting once a week for 3 hours did not give the students sufficient time to properly absorb the information and ask questions regarding their understanding prior to moving on to the next lecture.

In an open response forum, students gave very constructive feedback to improve the course. Regarding homework problems, students commented that the textbook examples were not sufficient in understanding how to properly set up and execute the homework assignments. Students requested more hands-on activities (labs) for some of the learning modules. As an example, students struggled with the topic of intact transverse stability. This is a difficult topic to understand without a hands-on lab or analytical visualization. The instructor will pursue ways to further enhance the learning process with regard to additional example problems as well as hands-on activities to convey the learning objectives of the modules. These hands-on activities will need to account for the increasing number of students enrolled in the course remotely.

Conclusions

In conclusion, this paper describes the development of a multi-mode (face-to-face and distance), introductory-level course on the topic of Naval Architecture geared towards an audience of engineering and engineering technology undergraduate students with no previous maritime background. The goal of this course is to expose talented undergraduate engineering students to the marine industry and to prepare those interested in pursuing a career in this field with an introductory understanding of the complex nature of designing and building ships and other marine vessels. This course was offered in spring 2013 and fall 2013 to total of 46 engineering and engineering technology students. The feedback from these first two offerings was overwhelmingly positive. The instructor will continue to improve the course, as it will be a permanent addition to the university's undergraduate marine engineering program.

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