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Work in Progress: Mini Projects - Using News Articles to Promote Lifelong Learning and Expose Students to Engineering Breadth

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Introduction

Between mainstream and social media, as well as scientific evangelists published in a variety of media formats, society is inundated with stories regarding the next great scientific and engineering breakthroughs. Nowhere is this truer than in the biomedical engineering community. As bioengineering instructors, our students often come to us talking about new technologies or discoveries they saw in the news. Some news agencies do a better job than others of faithfully representing the science and innovation behind these discoveries while providing a document that can be understood by the general public. Seeing the enthusiasm our students display as they read about these new discoveries suggests it can be a valuable tool in capturing their interest in a variety of classroom settings. Singh, for example, has reported on using NASA science news articles to enhance learning in the physics classroom[1]. Gardner *et al*. have explored 'framing' of popular media in the biology classroom[2]. Minerick provides an example in a chemical engineering elective course wherein students are engaged in critical thinking within a semester long concept development project (seeded by initial consideration of research or news articles)[3]. This paper reports on the details and outcomes of the structured use of news articles across a range of course levels in order to expose students to engineering breadth while promoting lifelong learning.

Background

Within the Department of Bioengineering at Florida Gulf Coast University's (FGCU) U.A. Whitaker College of Engineering (WCE), students are exposed to a broad curriculum containing significant experiences in electrical systems, physiology, mechanics, materials, transport, and design. As our curriculum does not have specialization tracks, we expect our students to be competent across all of these areas; however, we realize there are likely certain classes that resonate more strongly with individual students compared to others. Furthermore, we recognize that many of the classes we teach only begin to touch upon the breadth across a particular area, and we sometimes are required to focus on topical fundamentals at the expense of exploring more recent advancements in the field. As such, we are using popular news articles to augment coverage and motivate students in a variety of courses. Student gains in information literacy, lifelong learning and overall enthusiasm for the field makes these types of projects an easy way to integrate current trends and advancements into the course curriculum, and provides a way to encourage student participation by making activities student-driven.

Our definition of a "mini project" is finding a recent news article about a current technology, advancement or innovation related to the course subject matter at hand, and investigating the science or technology described in the article. For many of these projects (see below for variations of this approach), the students are asked to summarize the described technology or scientific advance, using peer-reviewed sources to verify the claims made within the news article. Potential sources for these news articles are given to the students as a primer to this exercise, but the selection process is entirely student-driven, allowing the students to explore topics they personally find interesting rather than having instructors dictate appropriate topics. Depending on the course and /or instructor, the "mini" approach and specifics vary. We report

here on three variations on the "mini project" theme in courses that range from the freshman to junior year of our B.S. Bioengineering curriculum.

Introduction to the Engineering Profession

EGS1006L - Introduction to the Engineering Profession is a 1 credit hour freshman level course that is the gateway to all subsequent FGCU engineering courses. The course is designed to introduce the engineering approach to problem solving and the engineering design process, utilizing team-based learning. This is accomplished through an over-arching semester-long research project focused on discipline-specific engineering innovations. "Mini projects" are used in this class to encourage student discovery of new technologies or innovations within their field of study as a means of helping them select an appropriate topic for their research project. Over the first two weeks of the course, students are asked to identify four innovations or new technologies that are relevant to Bioengineering. Upon being introduced to the STEM librarian and participating in a flipped-classroom focused on information literacy skills, students are asked to pick one of the topics they initially identified and find three additional peer-reviewed resources that support or explain the topic more in depth. They also are required to develop a single slide highlighting the importance of this innovation in an effort to convince their teammates (11 teams of 4 or 5, chosen based on a survey developed through the CATME Smarter Teamwork system[a]) to select their innovation for the team's semester project. Teams submit their methodology for selecting their final project, and are given the rest of the semester to write a multi-page report on the innovation, along with a final presentation. Over the course of the semester, the students are introduced to concepts such as how to better read technical and peer-reviewed journal articles, effective communication (including how to communicate with a non-technical or mixed audience), and how to recognize bias in writing. In addition to developing these final papers and presentations, students are asked to provide feedback on draft reports from other teams, both within and outside their engineering discipline, as well as provide feedback on each team's final presentations.

Introduction to Biomaterials

BME3100C - Introduction to Biomaterials is a 3 credit hour junior level course required of all FGCU Bioengineering students. "Mini projects" are used in this class in a similar fashion as described above. Based on a knowledge and interest survey conducted on the first day of class, students are assigned a biomaterial application area and asked to find an article from the news describing a recently developed or evolving device or technology related to their assigned application area. Students then further research the chosen device or technology, describing it in a one-page summary supported by a minimum of three peer-reviewed sources. Upon vetting by the instructor, these summaries are provided anonymously to the class, and two rounds of voting by the class are used to narrow the topics based on overall student interest. Eleven student teams of 3-4 are then assigned these topics for further exploration, based on their topical interest as indicated by their second round of voting. A series of deliverables are assigned, both to improve information literacy and technical competency as well as to ensure the project remains on task. By the end of the semester, the student teams will produce a 5-7-page review article of their topic, as well as a 10-12 minute oral presentation summarizing their findings.

[a] http://info.catme.org

Bioengineering Product Design

BME4800C - Bioengineering Product Design is a 3 credit hour junior level course that introduces the engineering design process as applied to bioengineered products[4]. "Mini project" assignments at the beginning of the course are used to heighten student awareness and knowledge of the medical device industry, as well as to generate ideas for a rapid design challenge that culminates in teams developing physical prototypes for concept solutions. In the first week of the semester, each student individually identifies and gets instructor approval (to prevent duplicate topics, or head off topics that are not relevant) for their mini project theme. They then prepare a one page maximum (single spaced) summary report on their theme that describes not only a recently developed or evolving device or technology, but also the company (as appropriate) and the disease/medical problem addressed. All mini reports include a minimum of three references, including the primary news article. At least one image (chart, picture) must be included as a figure with caption. Students (18 in the 2014 class offering) also prepare and deliver a one slide mini presentation to the entire class (five minutes maximum time) that not only conveys a quick summary of the mini theme, but also introduces the theme to the entire class as a potential area for creative product development via the upcoming (team) rapid design challenge (RDC). Students are formed into RDC teams (6 teams of 3 in 2014) that are initially assigned to consider any of the mini themes that have been presented (their own or those from classmates), research them further, and prepare brief presentations with the goal of pitching to the entire class topics for the RDC where there appears to be room for innovation. A multi-voting method is then used where the entire class considers all the ideas presented, and focus down to one or perhaps two areas for teams to work within during the remainder of the RDC as they move from concept to prototype.

Discussion and Conclusions

Through these projects, students have explored a variety of topics that otherwise would not have been covered to the same degree, if at all, in the courses described here. Even though every student in these courses didn't explore every topic in detail, the fact that students are disseminating their results through oral presentations provides everyone in the class additional exposure to these topics. In addition to providing significant breadth within each course, these "mini project" assignments promote information literacy and life-long learning, important pieces for our curriculum not only in regards to ABET assessment, but also for our University's new 5-year Quality Enhancement Plan (QEP), an integral part of regional reaccreditation. By demonstrating the ability to find, analyze, synthesize and appropriately cite current scientific, engineering and medical literature in their final reports and presentations, students are able to demonstrate their knowledge of contemporary issues (ABET outcome j) and their ability to engage in life-long learning (ABET outcome i). Both of these outcomes play a significant role in fulfilling FGCU's QEP (FGCU Scholars), focusing on advancing writing, thinking, and information literacy in multiple courses across the curriculum of every major at the University. This program has a universal course common to all students at the University, and requires each program to identify a "gateway course", a second course in the major, and a capstone course where scholarship (as defined by Boyer[5]) plays an important role in the course. Assessment will be both longitudinal as well as interdisciplinary in nature, facilitated by one or more FGCU Faculty Scholars from each College.

Assessment of these projects is currently ongoing in the EGS1006L class, focusing on student assessment of their learning gains associated with participating in semester projects[b]. Additionally, longitudinal assessment is being developed to determine gains in information literacy[6] and improvement in the overall quality of student references[7] as these types of projects are introduced earlier into our engineering curriculum. Since the described EGS1006L course, including the use of a "mini project", was introduced into the curriculum this academic year, current junior and senior-level projects from appropriate Bioengineering courses will be used to determine baseline values for these longitudinal studies.

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[b] http://www.salgsite.org