

Work in Progress: Promoting Career Reflection Among Freshman BME Students

Dr. Emma Frow, Arizona State University

Emma Frow is an Assistant Professor at Arizona State University; she joined ASU in February 2015 with a joint appointment in the School of Biological & Health Systems Engineering and the School for the Future of Innovation in Society. She has graduate training in both the natural and social sciences, with a PhD in biochemistry and an MSc in science & technology studies. Emma is interested in the engineering imagination, particularly in the emerging field of synthetic biology. Over the past 6 years, her curricular and extracurricular teaching with engineers and scientists has been geared towards encouraging them to think about the broader social, ethical and political dimensions of their research and training.

Prof. Michael R. Caplan, Arizona State University

Michael Caplan earned his undergraduate degrees from The University of Texas at Austin and his PhD from the Massachusetts Institute of Technology. Following post-doctoral research at Duke University Medical Center in Cell Biology, Michael joined the faculty of Arizona State University in 2003, and he is now an Associate Professor in Biomedical Engineering.

Dr. Caplan's research focuses on molecular cooperativity in drug targeting, bio-sensing, and cell signaling. Current projects align along three main themes: local drug delivery, endothelial dysfunction in diabetes, and cooperative DNA diagnostics. Recent awards include the Jeanette Wilkins Award for the best basic science paper at the Musculoskeletal Infection Society.

Dr. Caplan teaches several classes including Biotransport Phenomena, Biomedical Product Design and Development II (alpha prototyping of a blood glucose meter), and co-teaches Biomedical Capstone Design. Dr. Caplan also conducts educational research to assess the effectiveness of interactive learning strategies in large classes (~150 students).

Work in Progress: Promoting career reflection among freshman biomedical engineering students

Introduction

The biomedical engineering (BME) program at Arizona State University includes a 14-week 'success' course in the freshman fall semester. The primary objective of this course is to introduce students to BME faculty and ongoing research in the department, and a secondary objective is to introduce students to a few topics important to their university success (e.g. academic advising, academic integrity, and career search resources). In our co-taught version of this course, we also emphasize helping students to understand realistic career paths for graduates with B.S., M.S. or PhD degrees in BME, and to set and work towards their personal career goals. Our additional objectives are motivated by the hypothesis that many students entering our BME program do not have a clear sense of the jobs or career trajectories available to them upon graduation, and that many do not hold realistic expectations of what they can expect to do in an entry-level job.

In fall 2015, we piloted a set of reflection activities with one section of this BME success course (18 students). Through these activities, students were encouraged to reflect on their choice of BME as a major, to articulate their career and personal goals, and to identify actions they could take while in college to help achieve their personal and professional aspirations. By integrating regular reflection, we hope to empower students to take ownership of their university educations, to develop an understanding of realistic job opportunities available to BME graduates, and to be pro-active in defining their career and personal aspirations. By comparing student responses to a survey given in the first week and final week of class, we seek to evaluate the impact of these reflection activities on students' understanding of BME career paths and their ability to articulate their choice of major.

Methods

Our section of 18 students met for 50 min per week over 14 weeks in fall 2015. All students completed weekly reflections as their homework assignments. 15/18 students signed consent forms to allow their homework assignments to be analyzed as part of our IRB-approved study. The weekly reflections comprised a variety of exercises, including:

- A set of reflections about the students' personal goals, based on a seminar course at Harvard called 'Reflecting on Your Life'.¹ We incorporated four of the reflection activities described for the Harvard course as homework exercises early in the semester. Students had to complete each exercise ("Time Allocation", "Developing 'deep' vs. 'broad' expertise", "Core Values", and "Life Aspirations") based on the instructions we provided, and write a ~1-page response to each reflection activity.
- Career preparation exercises, including writing a resume, reporting on a university-hosted career exploration event, taking an online assessment (Indigo) designed to measure workplace competencies (similar to a personality test and DISC assessment combined), and a written reflection on the students' visit to the engineering career services center.
- Academic success planning, including making a personalized major map and annotating an ABET student outcomes rubric with information on what parts of his/her college experience would help the student master that outcome.

- Listening and writing summaries of talks, for each of four faculty presentations and two alumni talks. The faculty presented on their career trajectories and research; the alumni focused on next steps for getting into medical school, and intellectual property law as a career path.

In-class written surveys administered during the first and final class focused on student motivations for choosing BME, their understandings of the career options available for BME graduates, and (for the final class survey) what they found most and least useful about the course in terms of understanding their own aspirations and futures. The written responses were analyzed by highlighting and noting the frequency of particular keywords or phrases (e.g., ‘research’, ‘design’, ‘quality assurance (QA)’, ‘technical sales’ and others). Each student’s pre- and post-course survey was compared to track similarities or changes in their responses. The coded responses were also pooled to identify emerging and common themes (as well as unique ideas) across the student cohort.

Findings

1) Motivations for choosing BME

Students’ motivations for choosing BME remained largely unchanged from beginning to end of the semester. They expressed a variety of personal motivations for entering the BME program, but common themes emerged across the surveys. Every student (15/15) aspired to use biomedical engineering to help others and/or the world in some way. Common responses mentioned being good at some combination of science / biology / physics / math (9/15), and interested in medicine / medical developments / engineering (8/15), but not wanting to pursue medicine to or work in a medical setting (5/15). Some students noted a wish to enter BME because of personal medical experiences or those of family members or friends (3/15). Several students cited good job prospects for biomedical engineering graduates (6/15), but the pre-course survey responses included no specific information about particular jobs available to graduates. One student indicated that BME was a good choice for them because the BME requirements included most of the courses they needed to qualify for medical school admission; she also talked about the importance of being a woman choosing a STEM career.

At the end of the semester, most students’ broad motivations for being interested in BME had not changed appreciably, but the students were more capable of describing how a specific path in a BME career would satisfy those motivations (see section (2) below). However, two of our students did change their overall position radically, deciding to switch out of the BME major. One of these students indicated ethical concerns related to the necessity of animal trials in the FDA approval process, alongside a realization of their desire to work outdoors. The other student decided that the amount of mathematics was more than the student wanted to do. Each of these students was able to articulate clearly how their new choice of major suited them better.

2) Understanding career paths for BME graduates

A survey of our alumni conducted in 2007, together with a recent analysis of the *ASU Biomedical Engineering* group on LinkedIn (with 1000+ alumni members), show that the most widely accepted entry-level jobs for graduates exiting our program with a B.S. seem to be quality assurance (QA), regulatory affairs (RA) and technical sales. Following our objective to expose students to realistic career paths in biomedical engineering, jobs mentioned and/or discussed in detail during our course included QA, RA, technical sales, supply chain management, patent law (alumni presentation), medicine (alumni presentation), and research/academia (faculty

presentations). Over the semester, we observed greater understanding among our students of possible career trajectories for biomedical engineers, as detailed below.

At the end of the course, students were noticeably stronger in their articulation of the career options available to biomedical engineers graduating with a B.S. The initial and final course surveys included the following question: “*Briefly describe what you think a biomedical engineering [sic] with a B.S. working in the biomedical industry does in their job. (For example, someone 2-3 years after graduating with a B.S. in BME).*” In the initial surveys, most students offered very broad and general suggestions of what careers awaited BME graduates, using terms such as ‘research’ (6/15), ‘design’ (6/15), solving medical problems (4/15), or helping people/the world (3/15). One student replied “I honestly have no clue.” In the final survey, responses became much more specific: 13 out of 15 students detailed one or more specific career paths pursued by BME graduates with a B.S., including quality assurance (11/15), regulatory affairs (10/15), technical sales (5/15), and supply chain management (1/15), and provided short summaries of what these jobs entailed. Only two students did not mention one of these careers: one mentioned ‘lab technician’, and the other replied “Help in industries. Do paper work.”

By the end of the semester, students also demonstrated a good understanding what kinds of biomedical engineering jobs require advanced university degrees. For example, none of the end-of-semester surveys included ‘research’ as an activity associated with a B.S. degree in BME, compared with 6/15 in the initial survey. Furthermore, the use of terms like ‘design’, ‘create’, ‘develop’, and ‘solve problems’ were no longer being proposed as core activities for someone with a B.S. degree in BME (as was prevalent in the pre-course survey, see paragraph above). Most students were able to calibrate their choice of degree with the career paths they saw for themselves. Within the student cohort, 11 identified a single desired job/next step, while 4 mentioned they were considering more than one option. Our students were diverse in their ambitions, with 3 considering medical training, 3 committed to PhD research, 8 wishing to pursue either a B.S. or M.S. in BME in order to enter industry (with the degree depending on the type of industry job), and 2 considering law school or industry. This diversity in student interests suggests to us the importance of discussing a wide range of career options within the course.

3) Linking future aspirations to current actions

As well as demonstrating a clearer understanding of job prospects and an ability to situate their career aspirations within this landscape, the end-of-course survey indicated student confidence in linking their aspirations to actions they could take at university. Student responses to the question “*What part of ASU101 was most helpful to you in thinking about your plans 3-5 years after graduation? How was this part of ASU101 helpful to you?*” identified several course components, including learning about different career options through alumni and faculty presentations (11/15), the time management exercises (2/15), and the visit to the careers center (1/15). Students identified these as useful for reasons including: “It helped me to plan ahead for my next four years here at ASU in terms of my extracurriculars and use of time”; “It opened my eyes to the things I need to start doing now” and, “I need to make sure that I attend career fairs and utilize my career resources to kick start my post-graduation plans.”

Conclusions and lessons learned

Among the students in our class, initial understandings of what industry jobs are available to graduates with a B.S. in BME were vague and often somewhat misguided, placing too much emphasis on research and design. Through the presentations, discussions and reflections used in our success course, students seemed to develop more realistic expectations about the positions

available to them upon graduation, and began to articulate their personal visions and career aspirations in more concrete terms. Students emphasized that the alumni presentations were highly valuable in helping them to reflect on their choice of BME as a major, and on future career prospects. We conclude that freshman success courses in BME should include presentations from recent graduates in entry-level job types available to biomedical engineers.

Building weekly reflections into the course structure also encouraged students to begin formulating specific, immediate actions they could take to work towards their career goals. The end-of-course surveys were confident and upbeat, conveying strong enthusiasm among the students for the course structure and material; even those who had decided to switch out of BME indicated that the course had been valuable and enjoyable. Based on this, we also conclude that helping to set realistic career expectations can be a positive and constructive experience for students in their freshman year.

References

1. Light, Richard J. How to live wisely. *The New York Times*, 31 July 2015; http://www.nytimes.com/2015/08/02/education/edlife/how-to-live-wisely.html?_r=0 (accessed 28 Jan 2016).