

Developing a podcast project to supplement chemical & biological engineering elective courses

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Justin Vento graduated with a chemical engineering degree from Manhattan College and became a process engineer in the petrochemical industry. After a few years, he pursued his PhD in chemical and biological engineering from NC State, where he studied and developed tools for microorganisms within the human gut microbiome. He then worked for a few years as a scientist at a synthetic biology company Ginkgo Bioworks in Boston, MA. He is currently a Visiting Assistant Teaching Professor at Villanova University. Justin is passionate about teaching the fundamentals of chemical engineering in an engaging manner while also developing new courses that introduce students to the evolving biotechnology industry.

Work-In-Progress: Developing a podcast series project to supplement chemical & biological engineering elective courses

Abstract:

Chemical engineering students are faced with many different fields they could enter upon graduation, and demanding curriculums make career development opportunities scarce. While core chemical engineering courses are typically set in their structure, elective courses offer an opportunity to encourage students to ponder their passions and develop purpose within their education. Furthermore, growing industries such as biotechnology offer new opportunities to graduates, although students are often unaware of such career paths. To address these gaps, we have developed a "podcast series project" as part of a new elective chemical engineering course in synthetic biology where we interview professionals during class who utilize synthetic biology in different industries or in academia. The project has three learning objectives: to introduce students to career paths for chemical engineers within synthetic biology, to showcase how synthetic biology can be used to solve world problems, and to highlight the interdisciplinary nature of synthetic biology. Students assembled a podcast project report throughout the semester that included asking questions to the speakers, reflecting on a set of speakers, and following up on one speaker area for new learnings. Introducing this type of organized guest speaker series in chemical engineering elective courses should bolster career development by offering students time to reflect on their own career path and by connecting them with professionals who bring diverse perspectives on evolving career paths available for chemical engineering graduates across emerging industries.

Introduction:

Chemical engineering curriculums include core courses such as Transport Phenomena and Unit Operations that teach fundamental chemical engineering concepts, foundational science and mathematics courses, and technical engineering electives. While core chemical engineering courses and foundational math and science courses have largely conserved learning objectives across programs, chemical engineering technical electives are more flexible in their structure and purpose. Such technical electives offer the opportunity to provide students with industry-specific knowledge and skills not covered in core courses or opportunities to combine subject matter for new learnings [1]. Also, while core courses are predetermined for students, technical electives offer the opportunity for students to choose what they learn and can be influential in helping students make career decisions. Recent research has discovered that student career choice is based on the interplay of social, cultural, and economic factors, and that many students often lack career development training [2]. Since engineering curriculums are often demanding, career development opportunities can be difficult to pursue outside of the classroom. Technical electives can help fill this gap by offering career development within the classroom, including introducing students to career opportunities within emerging fields. Here, utilizing guest speakers can be an effective modality to provide up-to-date information and diverse perspectives on ever advancing engineering industries.

Courses that utilize guest speakers have been shown to induce higher-order thinking and increased participation [3]. Furthermore, recent research by Jablon-Roberts and McCracken explored student perceptions of industry guest speakers and found that 86.1% of students enjoyed the experience, particularly when speakers provided insights into their day-to-day life and offered career advice [4]. Finally, guest speakers can serve as supplemental instructors for a course, offering complementary explanations of course content that together with the primary instructor may effectively reach a wider range of students with diverse learning styles [5]. Although many courses utilize guest speakers to supplement course content sporadically, projects that consistently incorporate guest speakers in a structured format including a dedicated assessment are scarce. Here, a “podcast series project” is implemented as part of a chemical engineering elective course in synthetic biology, the format of which should also be readily applicable to other engineering technical electives. The course contained 23 students and met two times per week, including a 90-minute lecture and a 160-minute lab period. The podcast series was comprised of ten 30-minute interviews via Zoom over the course of the semester with professionals harboring diverse roles within synthetic biology. The podcast project has three learning objectives associated with it:

1. Understanding career routes and applications with synthetic biology
2. Connecting synthetic biology with some of the world’s greatest challenges
3. Grasping the interdisciplinary nature of synthetic biology

The first two learning objectives strive to enhance career development training for chemical engineering undergraduates interested in synthetic biology or other biotechnology-related fields. More specifically, the second learning objective connects the field of synthetic biology with student passions to help students decipher whether they identify with career paths in this field. This objective is supported by the notion that identity is a key variable in engineering students choosing their career path [6]. The podcast interviews include technical questions posed by the primary instructor and the students, allowing speakers to explain theoretical concepts behind their work. The speakers often have roles that combine principles from various engineering, science, and mathematics courses. Therefore, these case studies enable students to apply previous learnings to obtain new knowledge of an emerging field (learning objective three). The three learning objectives were assessed via a “podcast project report” that includes notetaking during interviews, asking questions to the speakers, reflecting on a subset of the episodes, and exploring one of the case study areas a bit deeper. Overall, this podcast series project should offer career development training for students and aid in the introduction to emerging opportunities within engineering fields. While the project was designed for a course in synthetic biology, the structure should extend well to other emerging fields including biotechnology, sustainable energy, and advanced materials.

Podcast Series Execution:

Over the course of the 15-week semester there were ten weekly podcast speakers from Weeks 3-12. The full breakdown of the podcast speakers is shown in **Table 1** and **Figure 1**. A diversity of speakers was chosen to represent career paths in industry vs academia, size of employer (for industry speakers), and location of employer. Each speaker was also chosen to represent a

different application area of synthetic biology. Live 30-minute interviews were conducted with each speaker during normal class time. Speakers were asked to join a Zoom meeting with their video on so the meeting could be projected to the class, enabling students to interact with the speaker and see their presentations.

Speaker	Position	Area
1	Researcher & Co-Principal Investigator	Microbial Cell Factories
2	Assistant Professor	Microbiome Engineering
3	Scientist	Protein Engineering
4	Co-Founder & CEO	DNA Storage
5	Scientist II	CRISPR Technologies
6	Senior Organism Engineer	Agriculture
7	Scientist	Epigenetics
8	Co-Founder & CSO	Climate Technology
9	Scientist	Stem Cells
10	Research Scientist	Fermentation

Table 1: Details of guest speakers in synthetic biology elective podcast series.

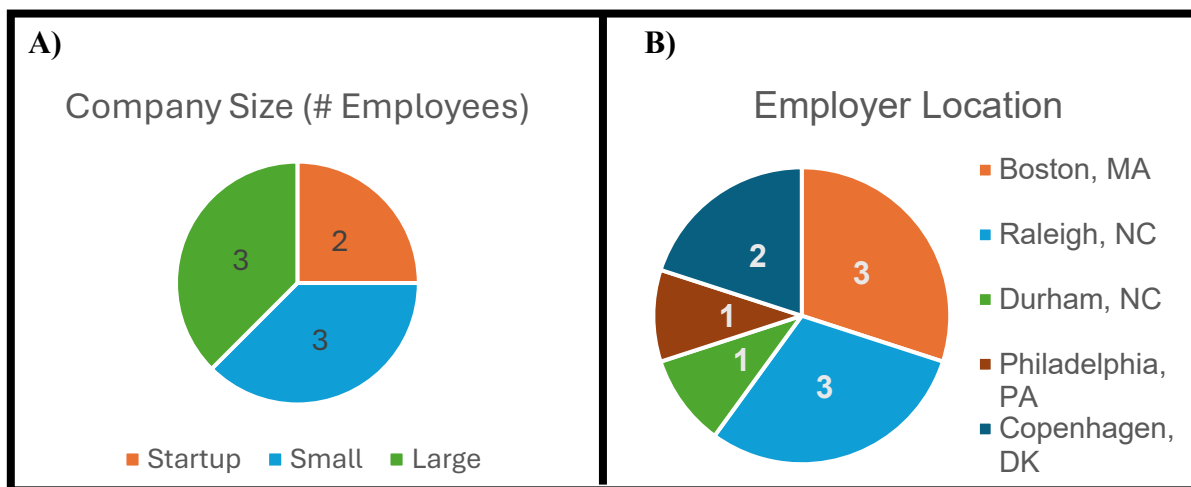


Figure 1: Further breakdown of podcast series speakers. A) Industry speakers were chosen from startup (< 30 employees), small (< 200 employees) and large (> 200 employees). B) Location of employers.

During the interview, the instructor asked a series of questions agreed upon with the speaker beforehand to guide the speaker through a visual presentation (i.e., Power Point slides). Questions fell into four categories: i) personal story, ii) societal impact, iii) technical details, and iv) general career advice. A sample set of questions for one of the speakers is shown in **Table 2**.

#	Question	Category
1	Tell us about your path into synthetic biology.	Personal Story
2	What types of problems do the labs/companies you've worked for try to solve?	Societal Impact
3	What types of biological systems does your current company build to solve these problems?	Technical Details
4	What advice do you have for a chemical engineering major who is interested in using synthetic biology in their career?	Career Advice
5	What was most beneficial about your chemical engineering background in hindsight?	Career Advice

Table 2: Example set of questions asked to a podcast speaker by the instructor.

Podcast Series Assessment (Preliminary Results):

A podcast report packet was distributed to students at the beginning of the semester, with a grade breakdown shown in **Table 3**. The report was worth 10% of the overall grade in the course. Active participation points were earned by students taking notes during all interviews and asking at least two questions during the semester. A Word document was provided with space to take notes, including guided prompts such as:

1. What problem(s) are the speaker trying to solve using synthetic biology?
2. What stands out to you about the speaker's path and/or their work or advice?
3. Describe the biological systems that the speaker builds with their work.

Item	Potential Points
Pre-Assessment	10
Post-Assessment	10
Active Participation	20
Reflection	30
Follow-up Slide	30
Total	100

Table 3: Grade breakdown for podcast project report.

At the end of the podcast series, students wrote a reflection that included a single paragraph on four of the speakers from the semester that they found interesting. The paragraph included the speaker's path, the problems they are trying to solve, and how they apply synthetic biology. Students were specifically asked to include any insights they gained from the episode. Additionally, students generated a follow-up PowerPoint slide on a topic covered by one of the speakers that they wanted to learn more about. The reflection and slide were graded based on completion, although incorporating a rubric in the future should better assess whether students demonstrate growth in key learning objective areas. The final 20 points of the podcast assignment were awarded for completing a pre-course and post-course survey self-assessing how the course improved their knowledge of synthetic biology fundamental concepts, professional

opportunities, societal impact, and interdisciplinary nature. While this survey was originally intended to assess the learning objectives of the podcast assignment, the objectives were too closely related to the overall objectives of the course, making it too difficult to decipher whether the podcast assignment alone contributed to increases in perceived student understanding. The details of the survey can be found in another supporting manuscript (ASEE 2025, *accepted*). Nonetheless, more than a third of the class (8/22 responses) mentioned the podcast series as the aspect of the course they enjoyed the most, with many students mentioning that the podcast series introduced them to new career paths they hadn't considered and/or included valuable insights and career advice.

Conclusions and Future Outlook:

This podcast series project provides a framework for implementing an organized set of guest speakers who offer insights into career paths of chemical engineering-adjacent fields, case studies for new learnings, and general career advice. Future work will seek to implement this series in other chemical engineering technical electives, including biotechnology & downstream bioprocessing, and will include assessments more targeted at the podcast project learning objectives outlined above. While the current podcast report includes completion-based diagnostic and formative assessments, future courses should also include summative assessments [7], such as examining student retention of podcast speaker content by including a separate test or by incorporating podcast-related questions into other assessments in the course. Rubrics that assess career development skills could be created similar to what others have done to assess the development of entrepreneurship skills in the classroom [8]. Here, tools such as EPIC from the ENTRECOMP framework can be adapted to help students better self-assess their progression throughout the podcast series [9], [10]. Comparing the effectiveness of this podcast series project in multiple chemical engineering technical elective courses should help refine the best modes of deployment and assessment. Overall, this novel framework for incorporating a podcast series into the classroom should help students pursue career development skills within chemical engineering technical elective courses.

References

- [1] J. R. Reisel, "An Exploration of the Use of Technical Electives in Engineering Curricula," in *ASEE Annual Conference and Exposition, Conference Proceedings*, 2023. doi: 10.18260/1-2--42623.
- [2] M. R. Siddiky and S. Akter, "The students' career choice and job preparedness strategies: A social environmental perspective," *International Journal of Evaluation and Research in Education*, vol. 10, no. 2, 2021, doi: 10.11591/ijere.v10i2.21086.
- [3] L. S. Hemphill and H. H. Hemphill, "Evaluating the impact of guest speaker postings in online discussions," *British Journal of Educational Technology*, vol. 38, no. 2, 2007, doi: 10.1111/j.1467-8535.2006.00622.x.

- [4] S. Jablon-Roberts and A. McCracken, "Undergraduate Student Perceptions of Industry Guest Speakers in the College Classroom," *Journal of the Scholarship of Teaching and Learning*, vol. 22, no. 3, 2022, doi: 10.14434/josotl.v22i3.32317.
- [5] P. K. Tulsi, M. P. Poonia, and A. Priya, "Learning Styles of Engineering Students," *Journal of Engineering Education Transformations*, vol. 30, no. 2, 2016, doi: 10.16920/jeet/2016/v30i2/105438.
- [6] J. N. Magarian and W. P. Seering, "From Engineering School to Careers: An Examination of Occupational Intentions of Mechanical Engineering Students," *EMJ - Engineering Management Journal*, vol. 34, no. 2, 2022, doi: 10.1080/10429247.2020.1860414.
- [7] M. Vijayalakshmi, P. Patil, and G. Karikatti, "Effective Assessment Strategies for Project-Based Learning," *Journal of Engineering Education Transformations*, vol. 36, no. Special Issue 1, 2022, doi: 10.16920/jeet/2022/v36is1/22187.
- [8] E. Park, A. Leonard, J. S. Delano, X. Tang, and D. M. Grzybowski, "Rubric-based assessment of entrepreneurial minded learning in engineering education: A review," 2020.
- [9] A. Scroccaro, J. Engzell, C. Norrman, M. Bigatto, and C. Lundvall, "SKILLS ASSESSMENT IN INNOVATION AND ENTREPRENEURSHIP EDUCATION INITIATIVES," in *Proceedings of the International CDIO Conference*, 2023.
- [10] M. Bacigalupo, L. Weikert García, Y. Mansoori, and W. O'Keeffe, "EntreComp playbook Entrepreneurial learning beyond the classroom EUR 30245 EN," 2020, doi: 10.2760/77835.