

Work in Progress: Using Resume Reviews to Explore Skill Sets Valued in Biomedical Engineers by Recruiters in Industry, Healthcare, and Academia

Annie Wang

Annie Wang is a Molecular, Cellular, and Developmental Biology student at the University of Michigan graduating April 2023. She is interested in Molecular Biology, Physiology, and education. She has previously conducted engineering education research through the University of Michigan's Undergraduate Research Opportunity Program and plans to continue to explore education research throughout her career.

Cassandra Jamison

Cassandra (Cassie) Jamison recently completed her PhD in Biomedical Engineering (BME) with an Engineering Education Certificate at the University of Michigan. Her research interests focus on understanding and improving experiential, out-of-class experiences for engineering students. She has also worked with the College of Engineering Office of the Associate Dean for Undergraduate Education at Michigan to perform experiential education research for the last two years. Cassie previously received a B.A. in Engineering Sciences at Wartburg College (Waverly, IA) and a M.S. in BME from the University of Michigan (Ann Arbor). She will join Rowan University's ExEEd faculty in September as an Assistant Professor.

Jan Stegemann

Jan Stegemann is a Professor in the Department of Biomedical Engineering at the University of Michigan in Ann Arbor. He received BS and MS degrees in Chemical Engineering from the University of Toronto. Prior to earning his PhD in Biomedical Engineering from the Georgia Institute of Technology, Dr. Stegemann worked for five years at Boston-based W.R. Grace & Co. (later called Circe Biomedical), where his research focused on cell-based bioartificial organs. Dr. Stegemann's current research focuses on the use of extracellular environments to control cell function and the development of engineered tissues. He is also an active educator in the BME Design Program at the University of Michigan, with a focus on graduate-level medical product design and development.

Aileen Huang-saad

Dr. Huang-Saad is an Associate Professor of Bioengineering at Northeastern University and the Director of Life Sciences and Engineering Programs at Northeastern's Roux Institute in Portland, Maine. Dr. Huang-Saad is Deputy Editor-in-Chief of Springer's Biomedical Engineering Education and Division Chair for the American Society of Engineering Education's Biomedical Engineering Division. Dr. Huang-Saad's current research areas are entrepreneurship, innovation, and transforming higher education. She is funded by the NSF to explore the influence of the microenvironment of entrepreneurship education on minoritized populations, entrepreneurial ecosystems, and fostering graduate student professional development.

Work in Progress: Using Resume Reviews to Explore Skill Sets Valued in Biomedical Engineers by Recruiters in Industry, Healthcare, and Academia

Abstract. From its foundation, the field of biomedical engineering (BME) has strived to solve interdisciplinary problems involving engineering, biology, and healthcare, which has resulted in a field that is diverse in both subject matter and career opportunities. However, the wide range of subjects under the umbrella of BME has led to criticism of BME curricula for being too broad without providing enough depth in content to prepare students to be competitive against other engineering students in the job market. Furthermore, BME graduates receive lower starting salaries and have fewer discipline-specific job opportunities than other engineering discipline degree holders [1]. Thus, there have been many efforts to identify and understand skills and experiences that are of value to BME recruiters. This work in progress study seeks to explore what recruiters in industry, healthcare, and academia are looking for in BME graduates. The work is guided by the following research questions:

What qualities, skills, and experiences are recruiters looking for in potential BME hires? How can they be represented on resumes of BME undergraduates?

We will explore these questions by analyzing resumes designed to reflect the specific qualities desired by BME recruiters in different fields (i.e., healthcare, academia, industry). The creation of these designed resumes (DRs) was based on content in resumes collected from fourth year BME students at a large R1, public university. Thus, the DRs reflected the experiences and skills of typical undergraduate BME graduates. DRs were also based on previously published rubrics used to evaluate the strength of resumes based on three distinct career pathways in BME: academia, industry, healthcare [2]. Using these rubrics as a guide, the DRs vary in strength and alignment with the three different career pathways.

DRs are currently being distributed to recruiters along with a survey, which asks respondents to rank four DRs according to strength and identify the applicants that they would offer an interview to. This survey also seeks to capture qualitative data about what is important to recruiters, including the skills and experiences that the evaluators deem most impactful and the reasoning for their resume rankings and interview offer decisions. The work presented in this paper will discuss the process of creating the DRs based on the rubrics, and the current response rates of the survey at the time of paper submission.

In our future work, we plan to perform a comparison of our expected rankings of the resumes from the recruiters based on the rubrics from [2] to the collected survey responses. By comparing recruiters' evaluation of the student resumes, both quantitatively and qualitatively, to the scores and strength of the resumes according to the previously established rubrics [2], we seek to understand whether our current understandings of BME skillsets align with the qualities that recruiters deem to be valuable in student resumes. The results from this study can help undergraduate BME programs and students understand what BME recruiters value for employment in healthcare, industry, and academia.

Study Design

Resume Development. A total of seven resumes with varying levels of strength in each career pathway (Academia, Industry, and Healthcare) were developed for this study based on resumes

collected from BME undergraduate students at a large, research intensive, public university. These resumes provided examples of experiences and skills that BME undergraduates likely possess upon the completion of their bachelor's degree and were essential to the creation of the DRs.

A set of three rubrics (Academia, Industry, and Healthcare) from a previously published work also guided development [2]. During the designed resume development, McCarty and Furtney [2] were contacted for advice regarding the application of the rubrics to the DRs of this study. The rubrics used a quantitative approach to analyze the strength of BME resumes by organizing common BME skills into tiers based on their presumed importance in academia, industry, and healthcare. While there are many sectors within industry and academic research that require variable skills and experiences, these rubrics allowed us to explore differences in generalized skills for the three major career pathways of BME graduates. As an example of the potential value differences for the same skill across the major career paths, the skill "academic research" is categorized as a Tier 2 skill in the Industry rubric, a Tier 5 skill in the Academia rubric, and a Tier 4 skill in the Healthcare rubric. The differences in the content of the rubrics' skills tiers were used to design resumes with varying levels of strength in the three career pathways. These seven

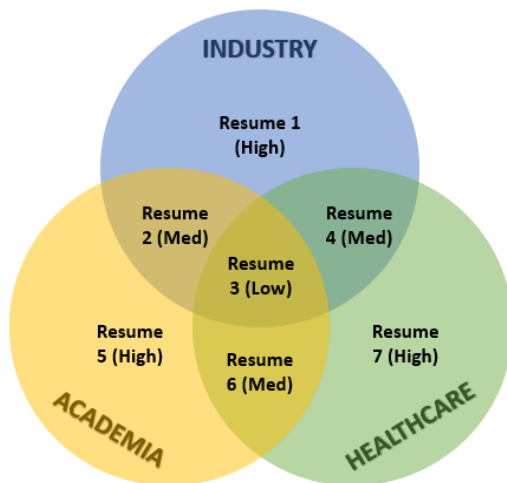


Figure 1. Organization of Designed Resumes of Differential Strengths into Academia, Healthcare, and Industry Sets.

DRs were organized into the three pathways (Academia, Industry, and Healthcare) such that each set contained a high scoring resume, two medium scoring resumes, and a low scoring resume (Figure 1). Each pathway had a unique high scoring resume (Resumes 1, 5, and 7 in Figure 1). A single low scoring resume (Resume 3 in Figure 1) with low specificity and quality of skill was used for all three resume sets. Three total middle scoring resumes (Resumes 2, 3, and 4 in Figure 1) were designed to overlap across two different career pathways. For instance, Resume 4 is representative of the DR that is middle scoring for both the Industry and Healthcare rubrics and is part of the Industry and Healthcare resume sets presented in our survey.

An initial round of coding using the rubrics was conducted on the DRs to evaluate the variation in resume strengths within each resume set. The coding demonstrated evidence that the DRs were appropriately varied in experience value within the different fields according to the quantitative rubrics [2]. Because the rubrics we applied were not designed to assess only undergraduate students, the scores for DRs that were designated as "high" in each career path category averaged around 5 on a scale that goes up to 6 (see Table 1). The average rubric score difference between the "high" resumes and "low" resumes we designed was 1.05 or higher.

Table 1: Designed Resume Scores Based on Previously Developed Rubrics

| Track | High Scoring Resume | Low Scoring Resume | Score Difference |
|------------|---------------------|--------------------|------------------|
| Healthcare | 4.45 | 3.4 | 1.05 |
| Academia | 5.05 | 3.85 | 1.2 |
| Industry | 5.1 | 3.9 | 1.2 |

Survey Development. Following the creation and initial coding of the DRs, a survey was developed to collect employer evaluations of the resume sets. Each employer was assigned a single resume set with four DRs based on the employers' self-identified career pathway (see Figure 1). For each pathway, employers would view a high scoring DR, two middle scoring DRs, and one low scoring DR for that pathway. The survey contains questions that call for both a qualitative and quantitative evaluation of the resume sets. Quantitative questions include questions asking employers to rate each of the four resumes from poor to excellent (1 = poor and 5 = excellent), rank the resumes based on the likelihood of offering the applicant an interview, and answer yes or no to offering an interview to each applicant. The initial coding to establish scores based on the rubrics [2] will be used as a baseline expectation for ranking results from the data collected through the survey. As more data is collected, the alignment between the expected rankings based on the rubrics and employer rankings from the survey will be assessed. Furthermore, the ratings and interview offer decision questions will be used to assess questions of sensitivity of the rubric rating system. These measures will allow us to understand the relative difference in strength between a resume scoring a 4 and a resume scoring a 5 based on the rubrics.

Qualitative questions in the survey ask employers to unpack their thought process behind their rankings and ratings of the DRs and evaluate the features of each resume that guided their decisions. For instance, employers were asked to provide examples of content from each resume that strengthened the application and provide their reasoning for the qualification and disqualification of resumes for an interview. These data can provide an opportunity to adjust elements of the established rubrics and strengthen them as a tool to guide students' resume creation and educational participation.

Discussion

So far, we have collected responses from eight participants following its distribution to the authors social networks (e.g., via personal emails and LinkedIn). Much more data is needed to understand the skills desired by employers in each of the three career pathways. We are presenting this WIP at the ASEE conference to gather more data from a broader, more diverse audience and expand the reach of our current study members. In our future work, we will employ quantitative data analyses (e.g., t-tests, ANOVA) to explore patterns in quantitative data and inductive qualitative analyses to identify patterns in participants' open-ended responses. We intend to report on the findings from the analysis in a journal publication at a later date. Our current work can also inform the direction of other studies that want to further expand upon this effort. For example, since the preference differences of industry employers' specific focus areas is not explored in the current survey, researchers may want to adapt the resume rubrics from [2] and survey design from our study to explore these relationships.

References

[1] J. Berglund, "The Great Divide: Some worry of a gap between what is being taught in American university undergraduate BME programs and the job market," *IEEE Pulse*, vol. 6, no. 2, pp. 42–45, 2015.

[2] T. McCarty and S. C. R. Furtney, "Development of Quantitative Methodologies for Analyzing Biomedical Engineering Resumes And Their Use In Career Pathway Alignment," in *ASEE Virtual Annual Conference Content Access, Virtual Conference, July, 2021*.

Appendix A: Survey Outline

Based on the current position you hold, which of the following three career tracks do you feel most qualified to evaluate resumes for?

1. Academic (e.g., accepting students into BME graduate school programs)
2. Healthcare (e.g., nursing school, medical school, physician assistant programs, etc.)
3. Industry (e.g., biotech companies, med device companies, etc.)

If Academia, show Tom Jefferson, Paul Revere, Oliver Twist, Kennedy Johnson resumes
If Healthcare, show Theo Roose, Paul Bunyan, Oliver Twist, Kennedy Johnson resumes
If Industry, show Theo Roose, Paul Revere, Oliver Twist, John Appleseed resumes

Please spend about 5-7 minutes reviewing the following four resumes. Then use your review to inform your responses. Follow the below link to a Google Drive folder to review the resumes.

Section 1: Resume Ranking

- Please rank the resumes in order from most likely (1) to offer an interview to least likely (4) to offer an interview.
- How would you rate these resumes based on the strength of the candidate?
- Would you offer each of these resumes an interview?

Section 2: Open Ended Questions

- What about the top ranked resume made it stand out to you?
- Looking at the resumes you ranked number 1 and 2, what information on their resumes makes them a good applicant?
- Looking at the resumes you ranked last, what made you put them there?
- For each of the four resumes, what were the biggest positive features that you noticed first?
- For each of the four resumes, what were some features that you would have liked to see?
- In general, do you have any further insights to share regarding key experiences, skills, etc. that would lead you to offering an applicant an interview?

Appendix B: Sample Resume

John Appleseed

johnapple@institution.edu | 1234 Main St. Collegetown, US 12345 | (123) 456-7890

EDUCATION

Collegetown Institution - College of Engineering

B.S.E in Biomedical Engineering

- Cumulative GPA: 3.85/4.00

EXPERIENCE

Jones Laboratory, Biomedical Engineering Department

Research Assistant, Professor Indiana Jones

Month XXXX - Month XXXX

- Designed a CPAP mask attachment to improve accessibility for ALS patients using CAD
- Used milling and lathing techniques to make molds and surrogates for use in testing
- Aided in development of prototype for new coronary angioplasty device as well as in the accompanying publication and presentation process

Frontline Company

Research and Development Engineering Intern

Month XXXX - Month XXXX

- Developed intensive testing and operational protocol for the evaluation of different models of hydraulic lifts for improved efficiency and reduced operational expenses
- Utilized Python and SolidWorks to design tools operators to monitor hydraulic lifts
- Collaborated with fellow design team members, quality engineers, and teams of scientists to conceptualize and model lift designs

Houston Laboratory, Biomedical Engineering Department

Research Assistant, Professor Tex Houston

Month XXXX - Month XXXX

- Optimized surgical preparatory routine to cut total experiment time and material usage in half
- Performed engineering analyses using SolidWorks to virtually design, simulate, and verify a device for use in rehab for ligament strain and tear injuries
- Conducted survival surgery on mice, hundreds of hours of tissue digestion evaluation to characterize and test reprogramming abilities of cartilage tissue

Team THERMO

Internal Vice President, Project Lead

Month XXXX - Month XXXX

- Coordinated design reviews and showcases for all organizational project teams, facilitated collaborative meetings between project teams, coordinate recruitment efforts along with other board members
- Led group meetings and synthesized data for design presentations and reports, including descriptions of the full design process, market and stakeholder analyses, concept generation, and design verification
- Identified a need for a redesigned stability device to reduce cost and increase efficiency
- Reviewed IEC and ISO standards, developed and validated testing protocols
- Utilized 3D printing and CAD in the design process for the development of numerous prototypes

LEADERSHIP

University Biomedical Engineering Society (BMES)

External Vice President

Month XXXX - Month XXXX

- Strengthened relationships with alumni and other university chapters by organizing information sessions and communicating organizational accomplishments
- Mentored younger members, advised on class scheduling, resume review, and future goals
- Created and managed annual budget for organization, including coordination of fundraising events for community organizations

Biomedical Engineering Peer Mentor Program

Peer Mentor

Month XXXX - Month XXXX

- Advised students by performing resume reviews and giving interview advice
- Motivated current and prospective members to foster individual confidence and a strong sense of community within the program
- Created a welcoming environment while engaging peers in college preparation and career exploration

**ADDITIONAL
INVOLVEMENT**

University Club Tennis Team

External Vice President

Month XXXX - Month XXXX

- Coordinated and organized recruitment events including Fall Org Fair and Recruitment Weekend
 - Maintain contact with members of the recruitment interest list and established the organization's presence and recruitment efforts while at competitions and performances
 - Oversaw the duties of the Alumni Relations and Social Media Chairs
-