

## **Online Modules to Develop Upper-classmen Mentors for an Introductory Biomedical Engineering Course**

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## Abstract

The Effective Teaching and Management of Engineering Teams (ETMET) course provides biomedical engineering (BME) undergraduate students with the opportunity to mentor first-year BME students as lab managers in our introductory course, Biomedical Engineering & Design (BMED). Their role is integral, as BMED is a team-based, flipped, active-learning course. The lab managers mentor the first-year students on how to obtain and analyze data, present information in written reports and oral presentations, and divide group projects into manageable tasks to meet deadlines. Thus, the topics of conflict management, design of assessments, ethics, group development, peer review, public speaking, and technical communication are essential for lab managers to be successful mentors. We created seven three-to-five-minute videos to teach ETMET students about each of the previously mentioned topics throughout the semester and plan to test their efficacy next fall. We will first administer a baseline quiz at the beginning of the semester and then an end-of-semester quiz to assess the lab managers' understanding of the topics presented. We will follow up with a post-semester survey with two to three questions for each module. Students will rank their confidence using a Likert scale of 1-5, with 1 representing "Strongly Disagree" and 5 representing "Strongly Agree." Differences between pre- and post-modules will be assessed with Wilcoxon paired t-tests. Based on the data analysis and survey results, we can assess if these modules aided ETMET students in being better mentors to students in BMED and provided the necessary skills to navigate their engineering education as members of future engineering teams.

## Introduction

- "Biomedical Engineering and Design" (BMED) is mandatory course for undergraduate freshmen biomedical engineering students at Johns Hopkins University, introducing them to the core principles of engineering, design, and health inequity
  - It is group-based, flipped, and active-learning focused
  - Students meet weekly in lecture and in a laboratory setting
- BMED students are randomized and placed into groups of five students and each group is assigned to an upperclassmen undergraduate BME student mentor, a "lab manager" (LM), through the Effective Teaching and Management of Engineering Teams (ETMET) course
- LMs are vital in mentoring their freshmen students in the technical skills required for developing engineers: gathering and analyzing data, completing assignments and projects through efficient teamwork, as well as fostering oral and written communication skills through class presentations and reports
- LMs utilize their leadership skills through the topics of conflict management, design of assessments, ethics, group development, peer review, public speaking, and technical communication to support freshmen BME students through their introduction to engineering. Yet, there were challenges with ensuring that the material provided within the ETMET course was adequately understood by the lab managers.
- Our challenge was to develop and administer online leadership modules to support BME upperclassmen in their mentorship of an introductory BME course as they learn the technical skills necessary to pursue a future career in biomedical engineering

## Methodology

### Rationale of Each Module



- LMs help facilitate their student learning; therefore, lab managers need to understand how assessments are designed to best help foster students' understanding of the material
- LMs can provide targeted training, mentorship, or opportunities for growth to enhance technical skills within the team.



- Equips LMs with the skills and knowledge to address ethical dilemmas effectively
- BMED can present complex ethical challenges for BME freshmen and LMs must be prepared to navigate these situations with integrity and professionalism.



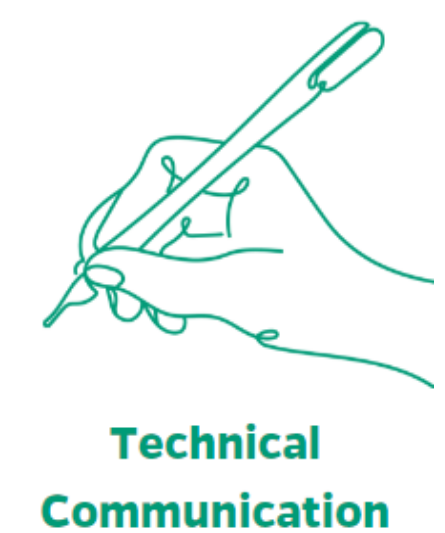
- Public speaking is a vital skill for the freshmen in BMED to acquire
- LMs guide BME freshmen in establishing effective public speaking skills to convey complex scientific concepts



- LMs can use peer review as a tool for BME freshmen to enhance their professional development, encouraging constructive criticism
- LMs can facilitate discussions on how to enhance research methodologies, data analysis techniques, and interpretation of results.



- Conflict management is important for LMs, as they are the first line responders to group conflicts
- Generally essential skill in future group work, as it has been found that project managers spend a minimum of 20% of their time dealing with conflicts.

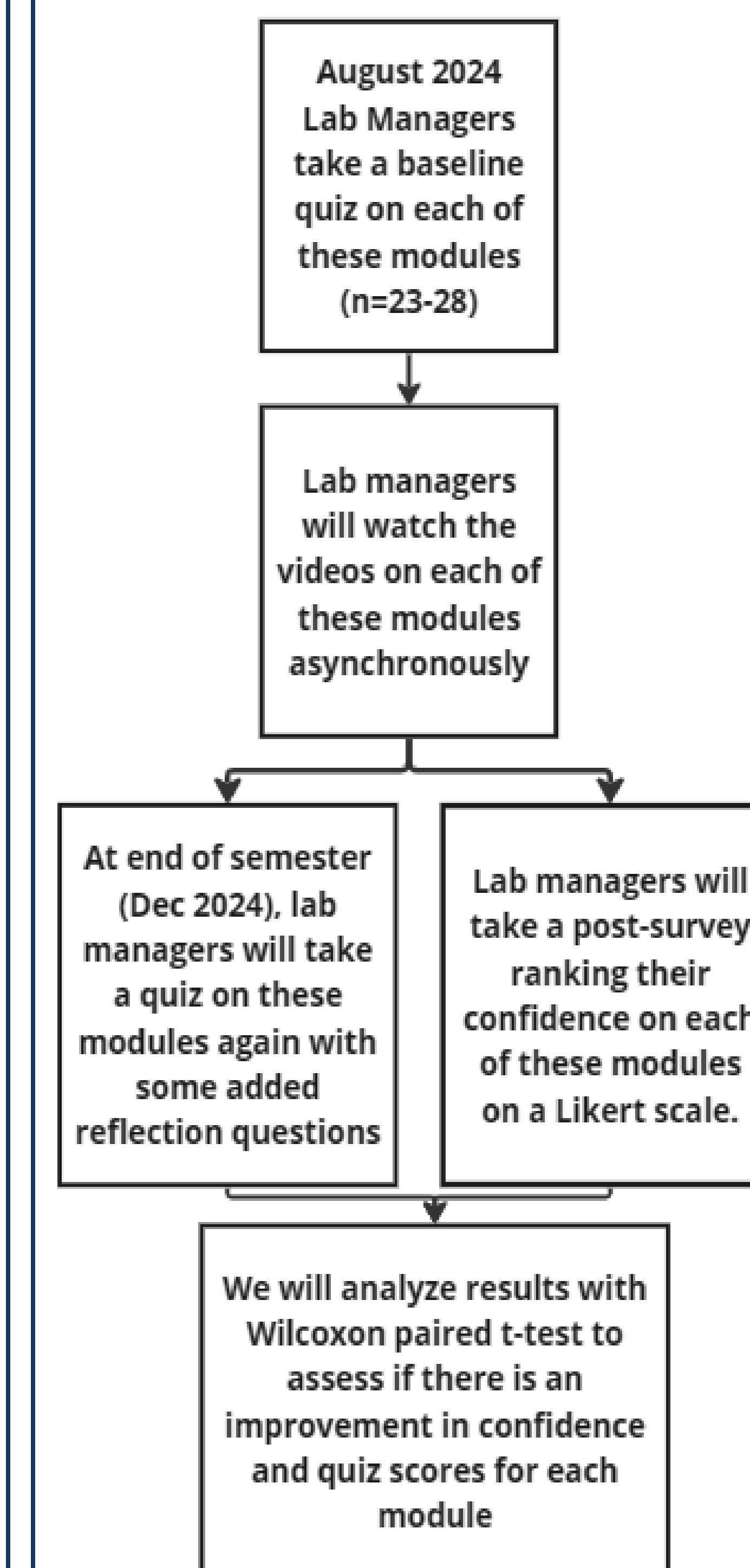


- LMs can utilize technical communication skills to support BME freshmen in conveying complex scientific data and analysis results.
- LMs must be proficient in communicating experimental procedures, results, and interpretations to facilitate data sharing, analysis, and decision-making processes.



- Group development principles help LMs build cohesive teams within the BME freshmen.
- By understanding the stages of group development (forming, storming, norming, performing, and adjourning), lab managers can effectively navigate the dynamics of team interactions and foster a sense of unity and collaboration among team members.

## Observations & Future Plans



**Figure 2 — Plan to test for efficacy of these module videos**

1. Baseline quiz: 15 MCQs polled randomly from a bank of 40 questions on Canvas. Untimed and close book.
2. LMs watch module videos and throughout semester practice applying skills with their group.
3. At the end of the semester, lab managers will take a 20 MCQ quiz from the baseline questions. Open-ended reflection question for each module.
4. Post-survey administered asking them to rank their confidence on each module before and after the semester on a Likert scale. "1" is strongly disagree and "5" is strongly agree.
5. We will analyze data using a Wilcoxon paired t-test to gauge if scores significantly increased from baseline to final assessments and if confidence increased from the Likert scale.

- The module videos were not required to watch; thus, there was minimal incentive for the lab managers to learn from these videos. The watch rate of the videos ranged from 28% to 44%, indicating that the module videos did not have a substantial effect on the lab managers' understanding
- Student feedback in the end-of-the-semester survey recommended inclusion of more active learning strategies such as role playing in-person. More suggested that we make the learning module videos mandatory and activities more engaging.
- In the future, we plan to introduce each video module throughout the semester with in-person exercises to supplement the modules.
- Each module will be introduced at an appropriate time for in preparation of what will be occurring in the course.
- The ETMET course faced challenges in communication and information dissemination to lab managers due to its non-traditional, asynchronous format, leading to confusion about video assignments and quiz timings. Improving interaction and clarity between instructors and lab managers will be crucial for enhancing mentorship and leadership training in future iterations of the course.