Summary of ABET Student Outcomes Assessment, 2023-2024
Bachelor of Science in Chemical Engineering
Chemical and Biomolecular Engineering Department
University of California, Berkeley
May 1, 2024

Executive Summary

This report presents the direct and indirect student outcomes assessment data collected from instructors and students during the 2023-2024 academic year. It is intended for use in department-level curricular continuous improvement efforts, and creates a record for current and future ABET program evaluators and decision makers.
This report follows the approach outlined in the Process: Assessing and Evaluating Attainment of Student Outcomes document adopted January 4, 2013. Part 1 reports the direct measures results by first reviewing the process and then presenting data sampled from the course Outcome Assessment Templates during the 2023-2024 academic year. Part 2 reports the indirect measures results by first reviewing the process and then presenting data from the spring 2024 graduating senior survey, and the 2023-2024 student focus groups (AIChE Student-Faculty Focus Group and Honors Student Tea). Part 3 summarizes the responses and outcomes from the 2022-2023 cycle.

Direct measures from student classwork indicate satisfactory achievement across most outcomes during the 2023-2024 academic year. However, Outcome 1 (solving complex engineering problems) and Outcome 4 (applying engineering design to produce a solution that meets specified needs) each displayed some course work measures falling within the 50-75% pass range, prompting a need for further review. Survey and focus group responses affirm students' confidence in their skills and abilities across most Student Outcomes, particularly in Outcome 7 (acquiring and applying new knowledge) and Outcome 5 (functioning effectively on teams). Students have suggested incorporating additional safety and ethics discussions into lower division courses.

Part 1: Direct Measures: Student Course Work

Process excerpt:

a. *Each Student Outcome is assessed in at least two core chemical engineering courses that apply the Outcome to a high degree.*
    i. *See Student Outcome-Course Matrix for mapping.*
    ii. *For each Outcome, core courses are chosen from different levels of the curriculum (such as sophomore and senior) so that the development of each Student Outcome may be monitored over time.*
    iii. *Each core course in the curriculum is used to assess at least one Student Outcomes.*

b. *Faculty and graduate student instructors of each course assess student course work and use the course Outcome Assessment Template to report the number of students who fail, pass, or pass with distinction each of the Student Outcomes.*
    i. *Outcome Assessment Templates are also used for course-level outcome assessment.*
    ii. *When a course-level outcome is highly similar to the given Student Outcome, the same measure is used for both.*
    iii. *See Outcome Assessment Templates for Student Outcomes for details.*
    iv. *Outcome Assessment Templates are collected each semester by instructor submission to a specified site in the Berkeley online course management system, administered by the department ABET coordinator.*

c. *In June of each year, the ABET coordinator generates a Quantitative Student Outcome Attainment report using the data from the Outcome Assessment Templates.*
    i. *For each Student Outcome, the lower level course is analyzed in odd calendar years, and the higher level course is analyzed in even calendar years. For example, Student Outcome 2 is analyzed in 40 (freshman) in 2019 and in 160 (senior) in 2020. *Beginning Fall 2022, core courses were no longer offered every single semester which might have impacted the order of assessment.*
    ii. *The Outcome Assessment Template data are used to calculate a percentage pass rate for each Student Outcome.*
    iii. *Trends in pass rate are monitored over time.*

Data: Student Outcomes-Course Matrix:

The Student Outcomes-Course Matrix has been updated to include data from courses on the Fall 2023 and Spring 2024 sampling schedule, in Table 1 below. Grey boxes indicate a course which is sampled in a different semester. Green, yellow, or red boxes contain the percentage of students who passed the outcome as measured in the course. Data collected during the 2023-2024 cycle show strong student achievement of most Outcomes, with some discussion warranted to examine the results for **Outcome 1** (identify, formulate, solve complex engineering problems), and **Outcome 4** (apply engineering design to produce solutions), both of which have some measure each in the "yellow" zone. This is not past the action threshold, but worth considering. All Outcomes have measures in the "green" zone, indicating that over 75% of students passed the Outcome by the course direct measure.

Table 1: Analysis of Outcome Assessment Templates for Student Outcomes

ABET Student Outcome	Measure from Outcome Assessment Templates	Year Analyzed	Year of Study	Fall 2023	Spring 2024
1- an ability to identify, formulate, and solve complex engineering problems by applying the principles of engineering, science, and mathematics	**141 - Thermodynamics** - Course Outcome #6: Calculate equilibrium composition or conversion in a homogeneous or heterogeneous chemical reaction.	2019, 2021, 2023	Sophomore		68%
	142 - Reaction Engineering - Course Outcome #6: Use the energy balance for either an adiabatic chemical reactor, a wall-cooled reactor, or a non-isothermal catalyst pellet, in conjunction with the mole balance, to find the reaction rate.	2020, 2022, 2024	Junior	65%	
	150 A - Transport - Course Outcome #3: Solve for the velocity field in simple geometries using the differential forms of conservation of mass and linear momentum.	2019, 2021, 2023	Sophomore		88%
	150B - Transport and Separations - Course Outcome #1: Solve steady-state and transient mass transport problems of engineering significance that involve diffusion and convection.	2020, 2022, 2024	Junior	67%	
	162 - Process Dynamics and Control - Course Outcome #2: Use principles of chemistry and physics to derive mechanistic process models.	2020, 2022, 2024	Senior	90%	
2- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	**40 - Intro to Chem Eng Design** - Course Outcome #1: Create a process flow diagram for a chemical or physical process protocol, applying standard process flow diagram conventions including stream labeling and standard names for physical and chemical unit operations.	2019, 2021, 2023	Freshman		
	140 - Chem Process Analysis - Course Outcome #8: Determine the design compromise for determining the temperature in a BSTR, a CSTR or a PFR.	2019, 2021, 2023	Sophomore	*	
	150B - Transport and Separations - Course Outcome #4: Design a binary distillation unit with various design specifications.	2020, 2022, 2024	Junior	85%	
	160 - Process Design - Course Outcome #3: Optimize the process simulation flowsheet based on heuristics, scheduling considerations, and the results of systematic variation of process parameters in the simulation package.	2020, 2022, 2024	Senior	100%	100%
	160 - Process Design - Course Outcome #8: Use profitability measures (such as net present value or Internal Rate of Return) to compare different process optimization schemes	2020, 2022, 2024	Senior	100%	100%
3- an ability to communicate effectively with a range of audiences	**40 - Intro to Chem Eng Design** - Course Outcome #7: Effectively communicate technical ideas to a mixed audience of technical novices and experts.	2019, 2021, 2023	Freshman		
	154 - Unit Operations Laboratory - Course Outcome #6: Effectively present technical information to an audience of technical experts.	2020, 2022, 2024	Senior	92%	100%
	170L - Biochemical Engineering Laboratory - Course Outcome #6: Effectively present technical information to an audience of technical experts.	2022, 2024	Senior	100%	95%
	160 - Process Design - Course Outcome #12: Communicate key process design decisions and analysis to an audience of technical project managers.	2022, 2024	Senior		100%

Color Key:

Grey- No data; course not offered or not on sampling schedule this semester

***Grey - No data; either the instructor didn't cover this topic or didn't collect data.**

Green- Over 75% of students passed this outcome by the course direct measure

Yellow- Over 50% of students passed this outcome by the course direct measure

Red- Action level: 50% or fewer of students passed this outcome by course direct measure

ABET Student Outcome	Measure from Outcome Assessment Templates	Year Analyzed	Year of Study	Fall 2023	Spring 2024
4- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	**140 - Chem Process Analysis** - Course Outcome #9: Deconstruct chemical accidents, runaway reactors, adiabatic flames.	2019, 2021, 2023	Sophomore	90%	
	142 - Reaction Engineering - Course Outcome #7: Analysis and awareness of reactive hazards including but not limited to hot spots and thermal runaway in packed-bed and stirred-tank reactors.	2020, 2022, 2024	Junior	65%	
	154 - Unit Operations Laboratory - Course Outcome #8: Recognize the ethical responsibility of engineers, and articulate morally justified solutions to ethical problems.	2020, 2022, 2024	Senior	90%	87%
	170L - Biochemical Engineering Laboratory - Course Outcome #8: Recognize the ethical responsibility of engineers, and articulate morally justified solutions to ethical problems.	2022, 2024	Senior	100%	95%
	160 - Process Design - Course Outcome #1: Discuss the principal issues in ethics, environmental protection and safety, including reactive hazards, as they relate to the design of new chemical and biological processes and retrofitting older plants.	2020, 2022, 2024	Senior	100%	99%
5- an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	**40 - Intro to Chem Eng Design** - Couse Outcome #6: Function effectively in teams to create a collaborative and inclusive environment for technical project work.	2019 ,2021, 2023	Freshman		
	154 - Unit Operations Laboratory - Course Outcome # 7: Function effectively on project teams, providing leadership to meet key objectives.	2020, 2022, 2024	Senior		94%
	170L - Biochemical Engineering Laboratory - Course Outcome # 7: Function effectively on project teams, providing leadership to meet key objectives.	2022, 2024	Senior	86%	88%
	160 - Process Design - Outcome #11: Function effectively on project teams by collaboratively stablishing goals, planning tasks, and meet objectives.	2020, 2022, 2024	Senior	93%	100%
6- an ability to develop and conduct appropriate experimentation analyze and interpret data, and use engineering judgment to draw conclusions	**142 - Reaction Engineering** - Course Outcome #8: Use real or simulated experimental data to determine the reaction order for a compound involved in a chemical reaction.	2020, 2022, 2024	Junior	75%	
	154 - Unit Operations Laboratory - Course Outcome #1: Set up and carry out an experimental plan for extracting information about chemical/physical processes.	2020, 2022, 2024	Senior	92%	100%
	170L - Biochemical Engineering Laboratory - Course Outcome #1: Set up and carry out an experimental plan for extracting information about chemical/physical processes.	2022, 2024	Senior	80%	95%
7- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	**40 - Intro to Chemical Engineering Design** - Course Outcome #5: Acquire and apply new knowledge, using appropriate learning strategies.	2019, 2021, 2023	Freshman		
	160 - Process Design - Course Outcome #10: Acquire and apply new knowledge, using appropriate learning strategies.	2020, 2022, 2024	Senior	100%	97%

Color Key:

Grey- No data; course not offered or not on sampling schedule this semester

***Grey - No data; either the instructor didn't cover this topic or didn't collect data.**

Green- Over 75% of students passed this outcome by the course direct measure

Yellow- Over 50% of students passed this outcome by the course direct measure

Red- Action level: 50% or fewer of students passed this outcome by course direct measure

Part 2: Indirect Measures: Student Survey and Focus Group

Process excerpt:

a. *Graduating seniors are surveyed about the Student Outcomes on the senior graduation survey administered by the College of Chemistry.*
    i. *Graduating seniors are asked to rate the level to which the curriculum prepared them to attain each Student Outcome.*
    ii. *The survey is administered in spring of each year.*
    iii. *Survey completion is required for tickets to the Commencement ceremony.*
    iv. *Survey results are reported to the Chemical and Biomolecular Engineering Department in spreadsheet format by August of the same calendar year.*

b. *Student focus groups occur twice each academic year, giving student representatives a forum to discuss curricular issues with faculty representatives.*
    i. *The AIChE Lunch is each fall semester, with 5-10 students from the Berkeley AIChE Student Section, including officers and non-officers across all years of study. *This year, due to the change of our ABET coordinator, it was held in the Spring semester.*
    ii. *The Honors Tea is each spring semester, with 10-15 chemical engineering honors students across all years of study.*
    iii. *During these focus groups, students are asked to consider the Student Outcomes and comment on those that the curriculum addresses well, and those that should be improved.*
    iv. *The student feedback is recorded in the meeting minutes.*

Data: Senior Survey:

Graduating seniors were surveyed on the degree to which they agree that they possess each skill or ability described in the Student Outcomes (1-7). There was an average of 117 responses for this year's survey, and the responses are summarized in Table 2 below.

This is the six year of data collection for the new Student Outcomes. A comparison to the five previous years data is shown in Table 3 and Figure 1 below. All outcomes have strong degrees of agreement, ranging from 69% to 83% agreement, and very low degrees of disagreement, with only 1% to 5% of respondents marking disagreement.

Outcome 5 (functioning effectively on teams) and Outcome 7 (acquiring and applying new knowledge) received the highest ratings this year, with 79% and 83% of respondents, respectively, agreeing that they possess these abilities, and only 1% to 2% disagreeing. On the other hand, Outcome 2 (applying engineering design to produce a solution that meets specified

needs) received the lowest rating this year, with only 69% of respondents agreeing that they have this ability, and 3% disagreeing.

Table 2: Senior Survey Responses 2024. Students were asked if they have each ability.

College of Chemistry Exit Survey: Spring 2024							
ABET Questions - Chemical Enineering Majors							
	Disagree		Neutral		Agree		Total
1-An ability to identify, formulate, and solve complex engineering problems by applying the principals of engineering, science, and mathematics	2%	2	28%	34	70%	86	122
2-An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	3%	4	28%	32	69%	79	115
3-An ability to communicate effectively with a range of audiences	2%	2	22%	25	77%	89	116
4-An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	5%	6	23%	26	72%	83	115
5-An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	1%	1	20%	23	79%	92	116
6-An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	1%	4	20%	23	77%	89	116
7-An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	1%	2	15%	18	83%	97	117

Table 3: Comparison of Senior Survey Responses from the preceding six years (since moving to Outcomes 1-7):

Senior Survey ABET Outcomes: Comparison of 2019, 2020, 2021, 2022, 2023, and 2024							
Percentage of Students Agreeing they have this ability							
	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5	Outcome 6	Outcome 7
Year							
2019	78%	79%	81%	86%	86%	79%	84%
2020	83%	81%	85%	85%	89%	82%	85%
2021	81%	85%	87%	87%	87%	77%	79%
2022	78%	72%	77%	79%	91%	78%	83%
2023	84%	74%	79%	86%	87%	80%	86%
2024	70%	69%	77%	72%	79%	77%	83%

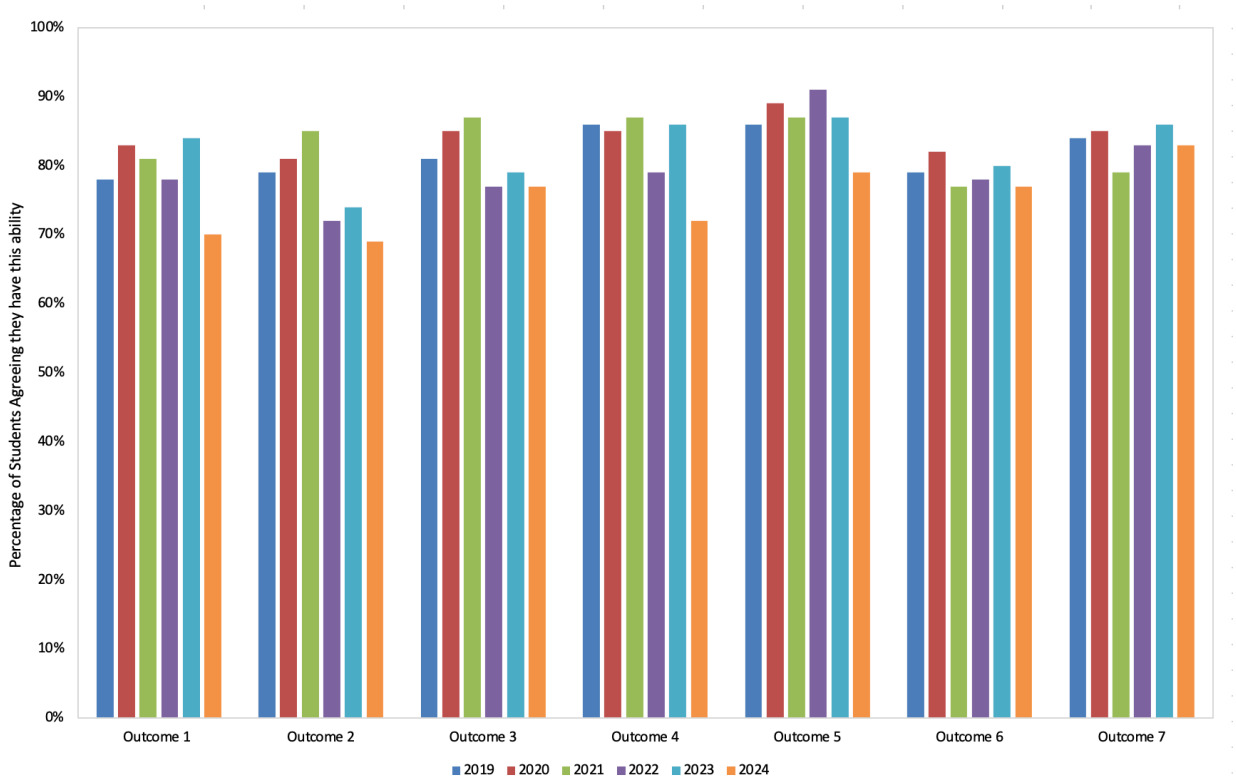

Figure 1. Comparison of Senior Survey Responses from the six years of data collection (2019-2024).

In Figure 1, we observe relatively consistent ratings for each Outcome 1-7 over the span of six years, although there are lower ratings for certain outcomes this semester. We attribute this discrepancy to the emphasis on ethics and safety within those outcomes, which may not have been directly taught to students.

This year, **Outcome 2** (apply engineering design to produce a solution that meets specified needs) received the lowest rating, with 69% of respondents agreeing they possess this ability, 28% expressing neutrality, and 3% in disagreement. Conversely, **Outcome 7** (acquire and apply new knowledge) was rated highest, with 83% of respondents agreeing, 15% expressing neutrality, and 2% in disagreement. Additionally, **Outcome 1** (solving complex engineering problems) showed a lower rating this semester compared to others, with 70% in agreement, 28% expressing neutrality, and 2% in disagreement.

Data: Student Outcomes Reflections from the AIChE Student-Faculty Focus Group, February 20, 2024:

The AIChE Student-Faculty Focus Group was held in-person on February 20, 2024. Seven AIChE officers and members spanning freshman through senior year attended. Four members of the faculty attended, including department chair Bryan McColskey, and three members of the Undergraduate Education Committee. In addition to comments on the ABET Outcomes (summarized below), the group also discussed the curriculum, and resources for students.

Reviewing Student Outcomes (1, 6, 7): Preparation for technical work in CBE (theoretical & practical foundation)

Students perceive that Outcomes 1, 6, and 7 are comprehensively addressed across various courses, equipping them well to tackle intricate engineering challenges. They express confidence in their academic preparedness, noting their ability to function adeptly within teams and to undertake tasks such as designing, conducting, analyzing, and interpreting experiments. Discussions arose regarding the new CBE math course, CBE130: Mathematics & Statistics in Chemical Engineering. Concerns were voiced by students regarding the course's employment of Python, whereas MATLAB is required for CBE142 and 162, depending on the instructor. The undergraduate committee clarified that mastering one coding language deeply should facilitate learning others. Additionally, faculty highlighted the transition of E7 (Introduction to Computer Programming for Scientists and Engineers) to Python. Students may fulfill the programming requirement with either CS 61A or Eng 7. A comparison between CS 61A and Engineering 7 was deliberated: CS 61A, a foundational programming course, emphasizes key concepts like debugging, code persistence, and writing clean, reproducible code. On the other hand, Eng 7 prioritizes numerical methods. Given that some Eng 7 material aligns with CBE 130, Chemical Engineering faculty recommend CS 61A. They underscore that CS 61A instills critical thinking and project design skills before coding, facilitating a smoother transition to CBE 130 and other upper-division CBE classes, which delve into the scientific aspects of coding. Despite the anticipated workload of CS 61A, faculty assure students that proficiency gained in coding will yield long-term benefits. Some students found the machine learning section of CBE130 at semester's end disconnected from the course's overall theme. Conversely, others appreciated the statistics module, as not all students have prior exposure to statistics, even at the high school level. The undergraduate committee also introduced students to the forthcoming Theory Concentration, offering additional coursework in Mathematics, Statistics, and Coding for interested individuals.

Reviewing the Student Outcomes 2 and 4: Ethics and Safety
While students acknowledge the efforts made by the CBE160 instructor to integrate Ethics and Safety into the curriculum and appreciate the two dedicated lectures in CBE154, as well as the completion of SAChE Safety and Ethics online trainings, they express a sense of inadequacy regarding the coverage of Ethics and Safety within their coursework. In response to this concern, the undergraduate committee reassured students that with the introduction of new teaching assistant faculty experienced in Safety Engineering in fall 2024, there will be an increased focus on these crucial topics. Additionally, there was a suggestion to integrate SAChE courses throughout the curriculum, ensuring that students receive continuous safety training across all semesters rather than solely at the senior level.

Reviewing the Student Outcomes 3 and 5: Communication and Teamwork
Students perceive themselves as adequately prepared for technical communication and express confidence in their ability to collaborate effectively within teams. They recognize that these skills are especially developed in courses that include team projects, like 160 and 154. Specifically, they found the oral presentations in 154, the final presentation in CBE160 with

Professor Tyson and industry professionals, along with the Chair, and the poster presentations in 170A and 170B at the end of the semester to be particularly beneficial.

Data: Student Outcomes Reflections from the Honors Student Tea, Monday, March 4, 2024: This year's tea comprised a comprehensive group discussion covering various topics, including class scheduling, grades, research, diversity and inclusion, concentrations, CBE 130, the new student experience, and Student Outcomes 1-7. Nineteen students and three faculty members participated in the discussion. A detailed list of student attendees and meeting notes is available in the CBE department's ABET folder on Box.

Responding to Prompt on ABET Student Outcomes:

ABET Student Outcomes (1, 6, 7): Preparation for doing technical work in CBE (theoretical & practical foundation)

The students in the group expressed confidence in their ability to acquire and apply new knowledge, particularly in relation to **Outcome 7**. They also acknowledged that the ChemE classes they are currently taking have equipped them with strong problem-solving skills, aligning with **Outcome 1**. Overall, they conveyed satisfaction with the mathematical and scientific foundation provided by the curriculum.

Regarding **Outcome 6** (design, conduct, analyze, and interpret experiments), the students emphasized the importance of research in developing essential skills for their future endeavors, highlighting it as a crucial aspect of their learning journey.

ABET Student Outcomes (2, 4): Ethics and Safety

Regarding **Outcome 2 and 4**, which pertain to Ethics and Safety, students acknowledged the presence of an ethics-specific course within the nuclear engineering department. However, they expressed concerns regarding the depth of exposure they receive in this area, suggesting a potential deficiency in critical thinking regarding ethics and safety matters.

Specifically, students noted that CBE 160 offers ethics content that is highly tailored to chemical engineering. Additionally, faculty members have proposed the identification of courses outside of the Chemical and Biomolecular Engineering (CBE) department that could supplement these emphases. Notably, courses in the fields of Nuclear Engineering, Data Science, and Bioengineering have been suggested as potential sources for further exploration of ethics and safety considerations.

ABET Student Outcomes (3, 5): Communication and Teamwork

Regarding communication and teamwork, students noted that these skills were effectively addressed in the capstone courses. Specifically, they praised CBE 40 for its comprehensive

coverage and highlighted the value of its group project, which they found beneficial for showcasing teamwork abilities to potential employers during internships.

They mentioned that CBE 154 and 160 are the courses where the majority of group work occurs. However, they also noted that teamwork isn't required until CBE 154, although courses like 170A already incorporate group projects. Additionally, some earlier classes have begun implementing "team homework" assignments, indicating a growing emphasis on collaborative work throughout the curriculum.

Part 3: Summary of Response to 2022-2023 Cycle

During the faculty retreat in January 2024, faculty members reviewed the data from the 2022-2023 continuous improvement cycle. Throughout this cycle, direct measures derived from student classwork showcased commendable achievement across all outcomes. The majority of outcomes demonstrated over 75% of students successfully meeting each criterion by the course direct measure, with the exceptions being CBE142 course outcome #6 and CBE150B course outcome #4 during fall 2022. It is essential to recognize that during Fall 2022, UC Berkeley GSIs went on strike immediately preceding the final exams, which had a detrimental impact on both student learning and assessment procedures. Consequently, numerous instructors were unable to grade entire exam/homework problems, which typically serve as samples of student work. We attribute the performance below the 75% threshold for these two outcomes to the challenges posed by the strike situation.

Survey and/or focus group responses show that students continue to be confident about their skills and abilities in most Student Outcomes, especially **Outcome 4** (apply engineering design to produce solutions), **Outcome 5** (function effectively on teams), and **Outcome 7** (acquire and apply new knowledge). They suggest some focus on improvement in **Outcome 2** (apply engineering design to produce solutions that meet specified needs). Some students have voiced concerns regarding the timing of the emphasis on ethics within the curriculum, suggesting that it comes too late. They advocate for additional content on ethics beyond safety-related considerations.

The faculty concluded that the current metrics are acceptable. During the retreat, the UEC discussed various aspects of the CBE130 course, including the topics covered and the lab sections. Some key points regarding the class profile emerged:

- There was a significant variance in the backgrounds and performance levels of students.
- Students entered the course with diverse backgrounds, with some finding it easier due to prior exposure to Math 54 (and 53), while others did not have this background.
- Approximately the bottom 20 students struggled, with some ultimately dropping the course due to difficulties such as solving problems using Euler's method and handling relatively simple ODEs.
- Conversely, some of the top-performing students excelled, particularly in solving challenging problems.
- Around 50-60% of the students grasped the fundamental concepts covered in the course.

- Many students faced challenges in understanding how to use equations without fully comprehending the derivations and underlying problem-solving frameworks.
- There was notable interest among students in statistics and machine learning, with several expressing a desire for more of these topics and less focus on differential equations.
- Some students expressed reluctance towards performing derivations and algebraic manipulations.
- Coding posed difficulties for some students, despite efforts to introduce basic Python concepts over two lab sessions. Some students resorted to copying and pasting code without understanding its intricacies.
- To enhance coding proficiency, longer lab sections were proposed, possibly incorporating live coding demonstrations during which main concepts could be explained.
- Consideration was given to adding a final project in the future to foster a more deliberate approach to coding and problem-solving.
- It was noted that the choice of programming language (e.g., Matlab vs Python) should not be a significant concern at this stage, as the focus should be on developing a coding mindset.
- Instead of a course like E7 that covers a mix of fundamentals and numerical aspects, it was suggested that students first establish a solid foundation in fundamental programming before delving into numerical problems.
- Taking course 61A was recommended as it could better prepare students for CBE130, potentially allowing for skipping introductory Python labs and focusing more on numerical methods and the scientific aspects of coding.
- The upcoming semester will provide an opportunity to assess the impact of offering E7 or 61A to students.

Additionally, the faculty discussed the ABET Self-Study Report and reviewed the current Chemical Engineering Program Educational Objectives (PEOs). Furthermore, there were discussions about the integration of Desktop Learning Modules (DLMs) into undergraduate courses, with two instructors expressing interest. Notably, during the spring semester, modules covering the double pipe heat exchanger, the venturi meter, and head loss were incorporated into CBE160. Furthermore, the headless module was integrated into CBE150 A. DLMs are low-cost, miniaturized, lightweight, see-through, easy and safe to use desktop experiments with which engineering students can conduct investigations to learn fundamental principles of fluid mechanics and heat transfer.