

How We Assess: Alternative Assessment

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Abstract

Alternative assessment has become increasingly widespread across engineering programs over the past decade. Instructors have been using different forms, including specifications-based grading, standards-based grading, and ungrading, and have also been experimenting with different degrees of assignment and assessment flexibility in their implementation. Strategies with implementation of alternative assessment include contract grading, self- or peer-assessment, mastery- or competency-based grading, and portfolio assessment. Students have benefitted from alternative assessment over traditional grading schemes by helping to reduce stress, providing flexibility in how they are able to demonstrate mastery of content and concepts, facilitating involvement in their own assessment, and increasing accessibility and equity in the course.

A nationwide survey of chemical engineering instructors was conducted, including those who have implemented and not implemented alternative assessment in their courses. Through the survey, a broader understanding of the reasoning behind alternative assessment's adoption or non-adoption, the obstacles and pitfalls experienced, and the benefits observed have been studied to determine commonalities and encourage paths forward. This paper will share instructor reflections and practical considerations for implementation in the classroom and chemical engineering curriculum. (This research study approved through IRB #25-05-48.)

Background

Alternative assessment encompasses a wide range of approaches in instructional assessment, including three primary forms:

- Specifications-based grading [1], in which grades are a reflection of students' completion of work to levels of achievement, with different tiers specified for each learning outcome;
- Standards-based grading [2], in which grades are a reflection of students' proficiency and mastery in the learning objectives, with different tiers specified for mastery;
- Ungrading [3], by which mastery and proficiency are the greatest emphasis in contrast to any emphasis on grades.

These terms are often misused interchangeably, with ungrading in particular being a common catch-all term used in place of alternative assessment itself.

Assessment techniques across both traditional and alternative approaches regardless of the specific type can be placed along two different spectrums [4,5]:

- Assignment flexibility. The assignments that must be completed by students in order to demonstrate their learning or performance in the course may rely on a specific set of assignments, or may be fully open-ended for students to select their own means of demonstrating their mastery.

- Assessment flexibility. This scale reflects a range from a specific rubric being applied, to more open options including mastery-based grading (applying a scale describing student ability such as ‘meets expectations’ and ‘needs improvement’), contract grading (assessment is applied based on work completed to different tiers), and self-assessment (students define their own grade based on learning demonstrated).

To reflect the assessment options available for instructors, these spectrums can be visualized as in Figure 1. Traditional assessment approaches are usually more restrictive in both assessment and assignment flexibility, while alternative assessment covers a much broader range of potential approaches.

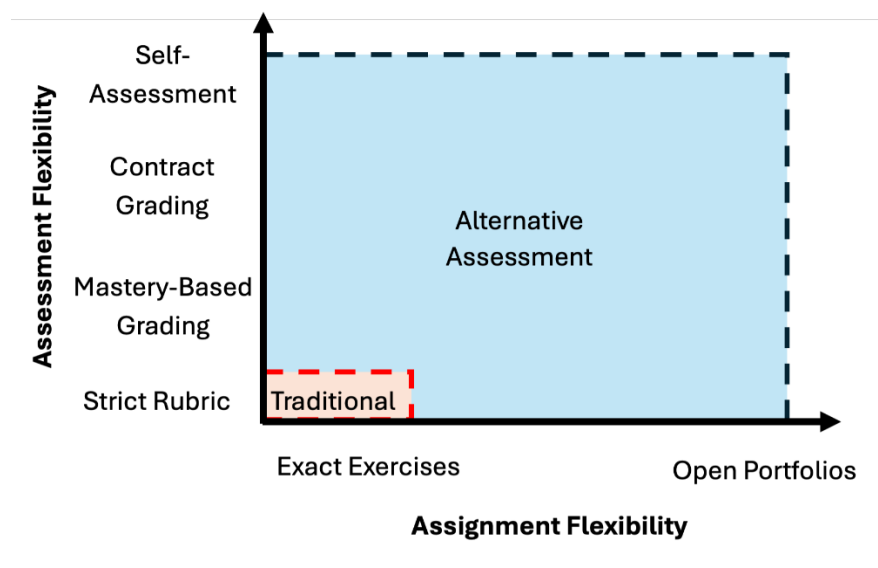


Figure 1. Depiction of forms of assessment approaches comparing flexibility in assignments and assessments. More traditional assessment is closer to the origin, while a range of approaches can be covered under the heading of alternative assessment [4].

The recent growth in implementation of alternative assessment and variety of approaches taken, as compared to long-established traditional assessment techniques, has been observed across several fields of discipline [6], with a range of benefits having been suggested from studies for both students and instructors. Benefits for students have included reduced student stress and a greater motivation to learn, while benefits for instructors have, in some cases, included better student-instructor relationships and higher academic standards [7]. Of note, the recent Engineering Mindset report specifically cited alternative assessment as a technique to be more readily adopted by instructors as education strives to meet future challenges [8]. With respect to the reported growing use of alternative assessment, however, there remains a need to determine how instructors in the field are currently conducting assessment, the challenges observed, and how instructors feel

about the assessment approaches they are using – effectively, seeking to assess how instructors are currently assessing and their motivations for their current approach.

Alternative assessment was thus the focus of a chemical engineering instructor survey conducted by the American Institute of Chemical Engineering's Education Division's Survey Committee. This survey was designed with the purpose of addressing several main objectives:

- Determine the breadth of alternative assessment implemented (and not implemented) by chemical engineering instructors
- Determine reasons for implementation, how implemented, obstacles, and impact observed
- Determine reasons for non-implementation
- Identify means to support potential further implementation

In the end of data collection, the survey collected 41 responses from chemical engineering instructors at 27 universities, with the hope that the results would provide more insight into the current state of assessment in chemical engineering instruction across the country.

Methods

Instrument

The survey consisted of approximately 30 questions, and was distributed through several chemical engineering mailing lists. These mailing lists include chemical engineering instructors associated with the American Institute of Chemical Engineering (AIChE) Education Division and the American Society of Engineering Education (ASEE) Chemical Engineering Division, as well as distribution through the mailing list for chemical engineering department chairs. Individuals that completed the survey were asked to suggest names of colleagues who the survey should be emailed to by the research team; these individuals were then contacted with the survey as well within the week. Respondents were also encouraged upon completion to share the survey directly with their colleagues. This data collection occurred over a two-month period in the fall 2025 semester. Upon presentation of initial data at the annual AIChE meeting, additional respondents were recruited from those attending the presentation as well as other AIChE Education Division events. Additional data collection then continued for another two months. No other reminders were provided for survey completion.

Respondents that did not complete the survey were not included in data analysis. All partial respondents did not include any further information after sharing their home institution – meaning no responses to the core questions asked in the survey – so all further data was analyzed in full without inclusion of these responses.

Respondents were asked a series of questions depending on whether they had or had not implemented alternative assessment previously, as the survey was meant to obtain perspectives and experiences from all instructors regardless of the assessment approaches they had previously

used. Participants who had used alternative assessment were asked to detail their instructional approaches for up to six courses they had taught with this assessment technique.

Most questions were asked in multiple-choice format, with the option for an ‘other’ open-ended response. The choices for these items were developed from the authors’ experience and prior literature on common motivations for implementing alternative assessment, challenges, and impact. Additional open-ended questions were asked with respect to participants’ opinions of their experiences, observations, and motivations. Open-ended responses were coded inductively based on responses provided, with codes produced by one member of the survey team and others reviewing the coding assignment.

While alternative assessment can go by many names, as previously noted, respondents were not given any definition or term defining the approach beyond ‘alternative assessment’. Thus, while ‘ungrading’ is often used interchangeably (and incorrectly) to describe all alternative assessment techniques, only the term ‘alternative assessment’ was used in the survey and in any messages recruiting potential respondents to complete the survey.

Participants

Of the 41 respondents, 24 were full-time non-tenure track, 5 were tenure-track, and 12 were tenured. The full-time non-tenure track respondents reported that their obligations were on average 71 percent focused on teaching and instruction, as compared to 34 percent for the tenure-track respondents and 37 percent for the tenured respondents.

Data Analysis

This study is exploratory, and each item was analyzed descriptively. For multiple-choice responses, frequency counts are reported. For the open-ended responses, the authors descriptively coded the data to document and categorize the breadth of opinions stated by multiple participants [9].

Results

Respondents reported a range of different experiences in current assessment approaches, as depicted in Figure 2. Of the respondents, 75 percent of non-tenure track instructors and 100 percent of tenure-track instructors had used some form of alternative assessment. This stands in contrast to 50 percent of the tenured instructors; overall 65 percent of respondents had implemented alternative assessment in some form. It is possible that, given an alternative assessment with relatively more recent implementation, the observed adoption rate reflects, in part, instructors’ longer experience with traditional assessment approaches. Of the respondents that reported having implemented alternative assessment, 44 percent had done so for only one course, while 56 percent had done so for 2 to 5 courses. The percentages may be reflective of the number of different courses the instructors are typically assigned to, meaning that the instructors implemented

alternative assessment in the majority of courses that they personally teach, rather than the number of courses that instructors had the opportunity for implementation.

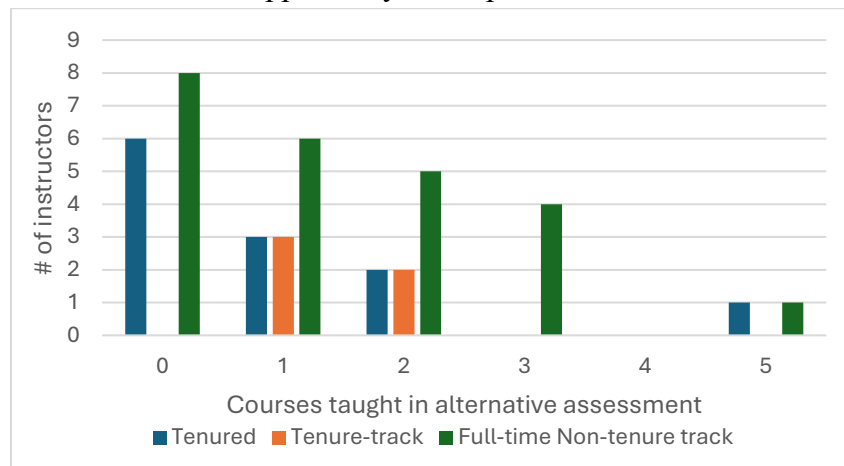


Figure 2. Number of respondents having delivered different numbers of courses delivered in alternative assessment approaches, broken down by instructor position.

Non-implementation of alternative assessment

The 14 respondents that had not implemented alternative assessment were asked a separate series of questions to determine their perceptions and concerns. In response to a question on why they had not yet implemented alternative assessment with a list of common reasons provided to choose from, respondents most strongly pointed to their unfamiliarity with the assessments themselves, their concerns about ensuring the grading was conducted fairly, and their own preference for traditional assessments. These responses are indicated in Figure 3.

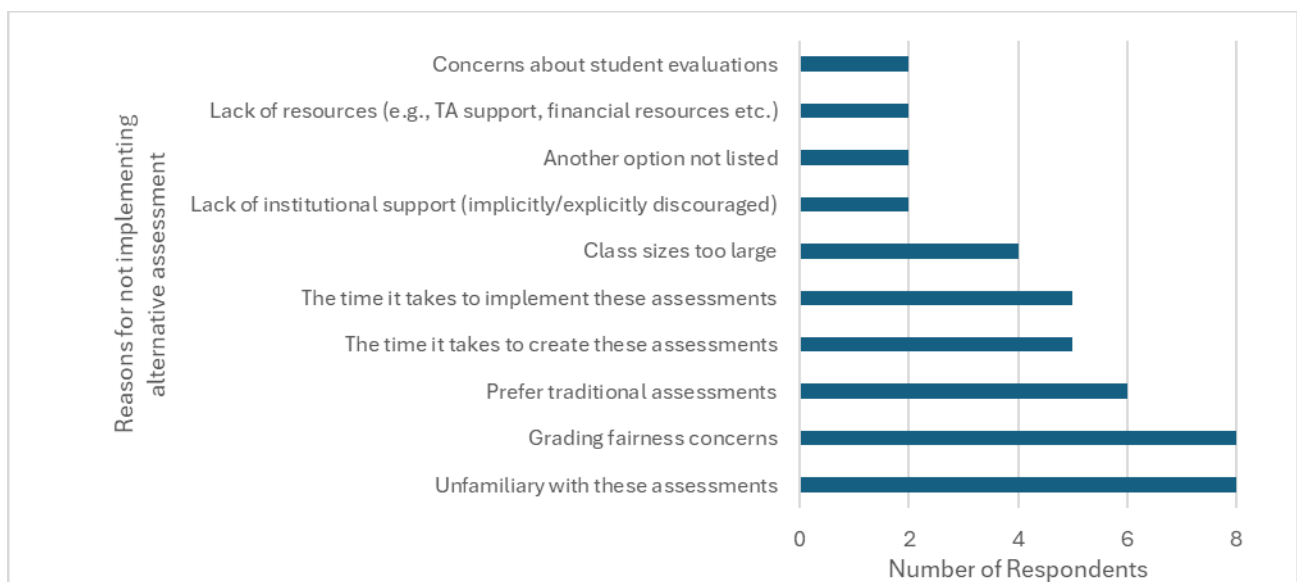


Figure 3. Number of respondents per reason for not implementing alternative assessment.

Additional reasons provided by respondents included that the FE and PE exam use a standard exam approach, and therefore the traditional exam approach should not be removed. This concern helps to point to a broader misconception that alternative assessment requires the elimination of exams; in fact, specifications-based and standards-based grading approaches both allow for standard testing procedures but just evaluate or connect exam performance to final course grades in potentially different approaches [1,2].

A larger question in connection with these reasons for not yet implemented alternative assessment is their attitude and feelings towards alternative assessment as a whole. These reflections could potentially indicate challenges in implementing or reasons why they might find it difficult to buy into a new approach. As such, respondents were then asked about their thoughts on alternative assessment specifically. Figure 4 depicts these opinions, with the most common again suggesting the focus on the rigor / fairness of the alternative assessment grading approach.

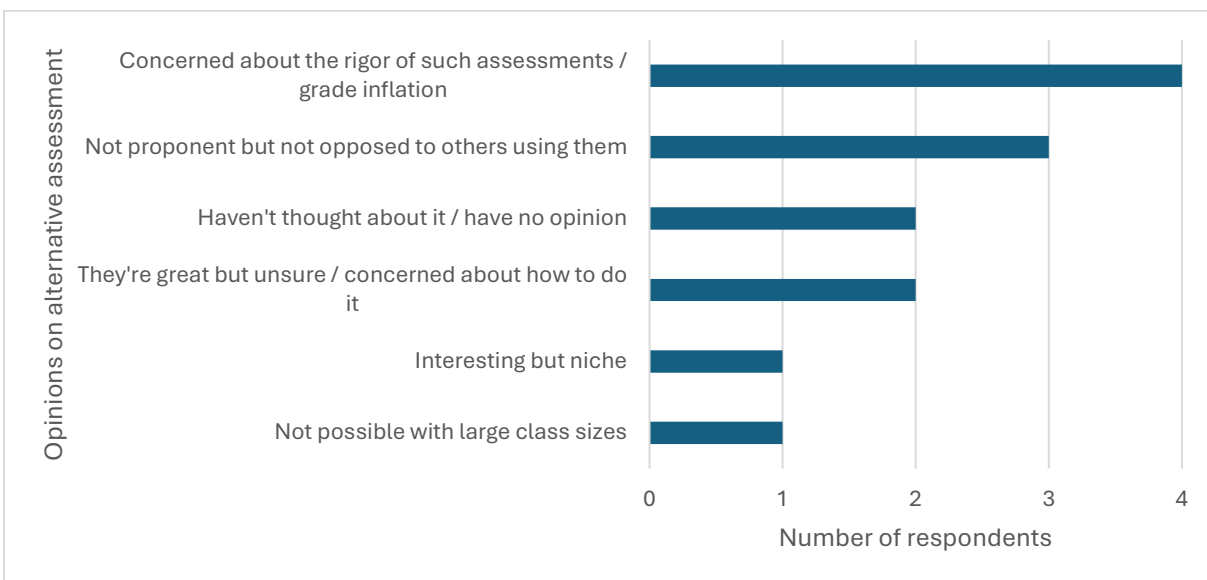


Figure 4. Non-implementing respondents' opinions of alternative assessment.

Based on these responses, respondents' provided additional information on what they would want or need to be willing to implement alternative assessment. These responses broke down into four categories as follows, with key quotes from the respondents provided:

Proof of effectiveness

- “A convincing argument that they adequately capture student attainment of the particular knowledge or skill”
- “Seeing data on its effectiveness on the students and their ability to succeed in college and beyond”
- “Years of people teaching large classes showing me how they do it effectively and efficiently”

- “Looking at the way alternative assessment approaches change learning and teaching versus how it changes assessments”

Institutional support

- “Support from my chair to try new things”

Training/guidance

- “Potentially additional training on how to perform it”
- “Seeing how it could be used in tandem with traditional assessment”

Grading strategies

- “Confidence that the students would apply my grading standards rather than theirs”
- “Strategies on getting buy-in and shared understanding with students on how grades will be assigned”

As advocates for alternative assessment continue to encourage other instructors to adopt these approaches, it would be helpful to consider these concerns of providing proof of effectiveness, helping to create institutional support, offering training and guidance, and showing strategies for the grading component.

Implementation of alternative assessment

The 65 percent of respondents indicating previous implementation in implementing alternative assessment techniques were given a series of questions regarding their experience. First, respondents were asked specifically why they do use alternative assessment, with responses indicated in Figure 5. The 27 respondents in this category were able to list multiple reasons in their explanation. The most common responses reflected on the very objective of alternative assessment, in that students are theoretically able to focus more on feedback and growth while the assessment itself provides a more complete evaluation of student mastery.



Figure 5. Number of respondents per reason for implementing alternative assessment.

Additional answers from respondents referenced that their department culture supports it, that it helps reduce cheating, that it helps reduce student stress, and they experienced a better student-faculty relationship.

Respondents were also asked to reflect on the challenges they had experienced in implementing alternative assessment, with the same list of reasons that non-implementing respondents had been provided as reasons why they had not yet used alternative assessment. Responses are indicated in Figure 6. It is worth noting that the most common challenges for implementation focused on the initial effort involved in implementation, while grading fairness concerns (the main reason cited for non-implementation) were still commonly expressed but not as frequently.

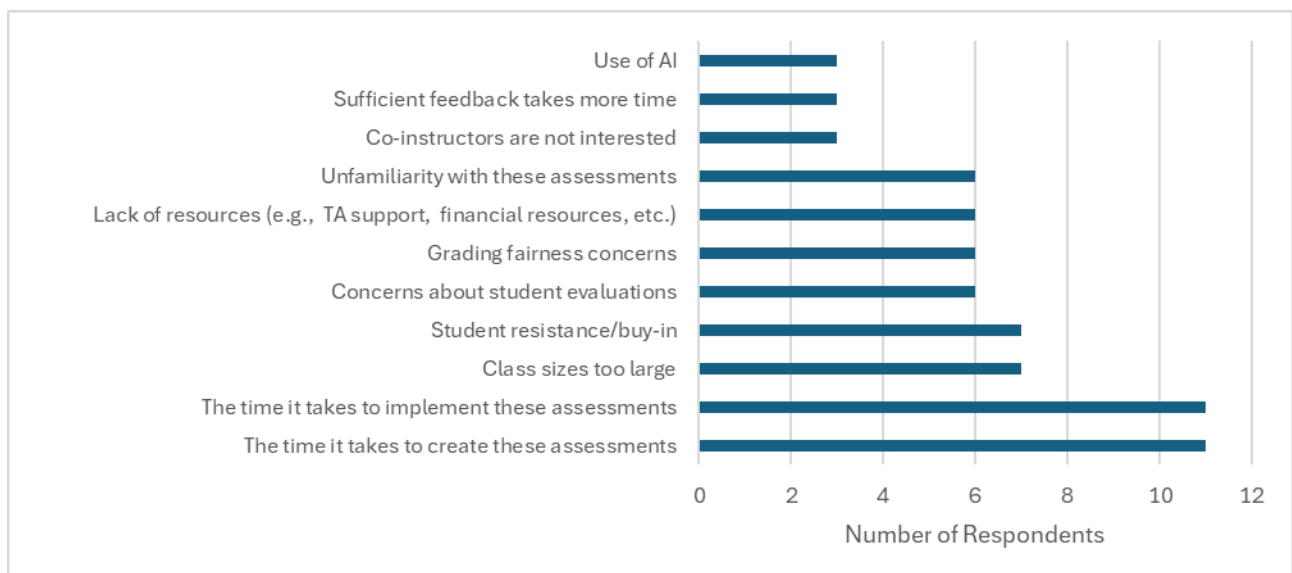


Figure 6. Respondents' largest challenges cited in implementing alternative assessment.

Additional challenges cited by respondents included how to evaluate group work as compared to individual work when seeking to evaluate individual mastery, the time necessary to train a TA to provide proper feedback, clear communication of standards, and student procrastination. An additional factor ties into the non-implementation response, in that students and instructors have the weight of their previous experience in traditional assessment. A lack of colleagues' support and institutional knowledge thus means that the initial time for design and implementation can be much higher, with instructors needing to also build student and colleague buy-in to the effort.

Given the challenges present, it was worth determining what respondents had observed in their experiences as the largest benefits from alternative assessment implementation. The most common responses are indicated in Figure 7.

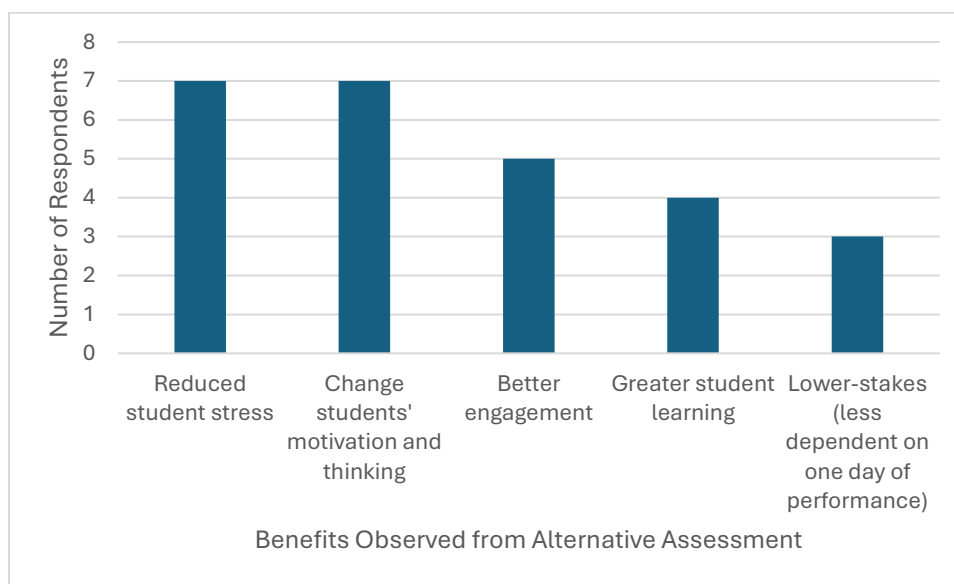


Figure 7. Number of respondents indicating benefits they observed from alternative assessment.

The most common responses identified reduced student stress and the positive impact on changing students' motivation and thinking in their learning efforts; other common observations included better engagement in the course because of the assessment structure, helping to result in greater student learning. Respondents provided a long list of additional benefits from their personal observations, many of which align with commonly cited benefits from educational studies. The additional reasons included higher standards being upheld, better conflict resolution skills being established between instructor and student, less time spent grading for the instructor, helping students achieve a separation their identity and self-worth from their grades, more student empowerment and ownership over their learning, better performance by lower-achieving students, and greater instructor excitement, among other reasons.

Current alternative assessment

Respondents were asked to describe the courses in which they had successfully implemented alternative assessment approaches. All of the traditional core chemical engineering courses were included, including Unit Operations Laboratory (5 instances), Transport (5), Mass and Energy Balances (4), Thermodynamics (3), and Capstone Design (3), with additional examples for Separations, Process Control, and Introduction to Chemical Engineering. Additional electives included Biopharmaceutical Engineering, Analytical and Numerical Methods, Industrial Chemical Processes, Polymer Processing and Sustainability, Green Chemical Engineering, and Biochemical Engineering among others. Respondents also indicated that the students in these courses ranged across all undergraduate years of study, as well as Masters' and Ph.D. students, as shown in Figure 8.

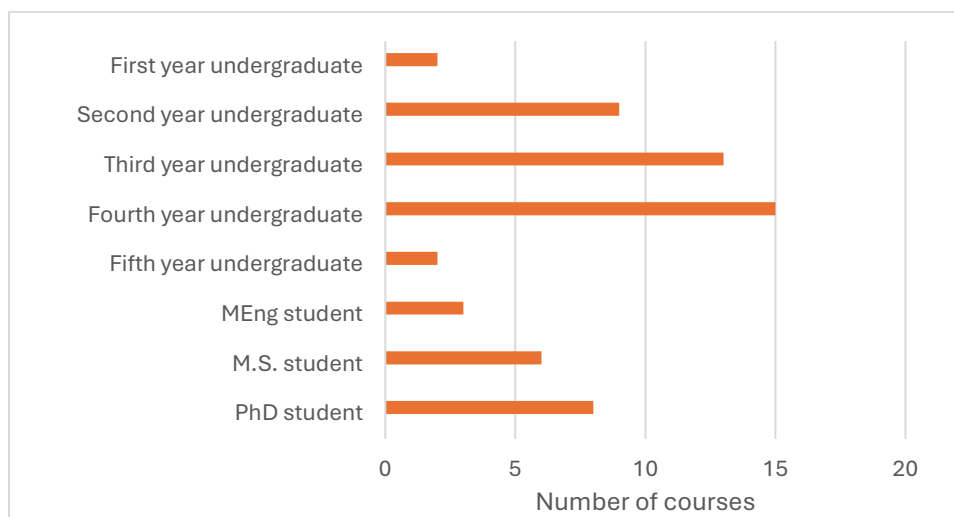


Figure 8. Types of students in the alternatively assessed courses instructed by the respondents.

As to the approach taken in alternative assessment on the assessment flexibility and assignment flexibility scales, respondents were asked to rate their flexibilities from 0 to 100, with 0 being closest to traditional assessment and 100 being the most open in alternative assessment form. Plotting these responses similar to the example provided in Figure 1, a range of styles can be observed in Figure 9, with most instructors having established some upper bound on the flexibility in assignments, but many different approaches being taken with respect to assessment flexibility. It is worth noting that any potential deviation from a tradition approach was considered by respondents as an alternative assessment approach, even if the instructors' rating of their courses still fell near the 'origin' where most assessment approaches would broadly be considered 'traditional'.

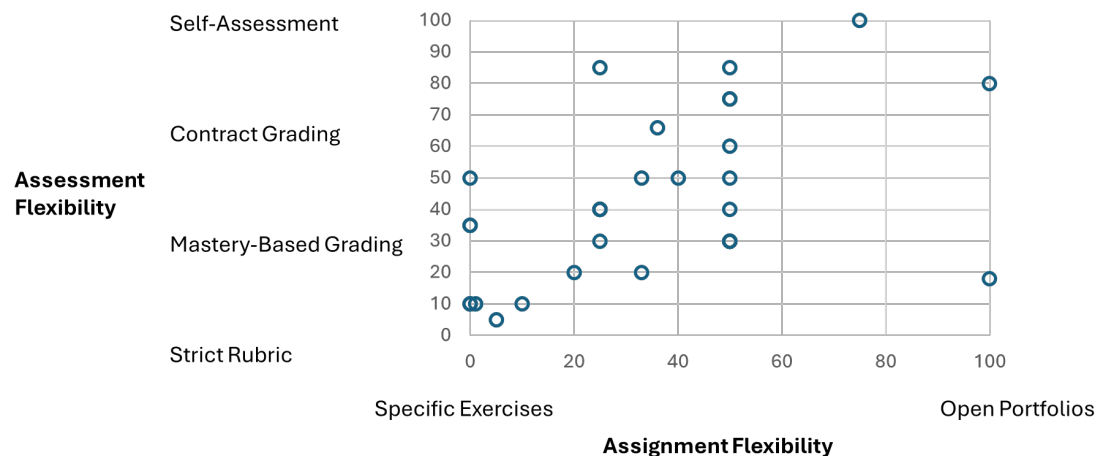


Figure 9. Respondents’ approaches to assignment and assessment flexibility in their implementation.

Important characteristics of alternative assessment include regular feedback provided to students, enabling their ability to identify the weaknesses in their mastery and continue to build upon those areas. Respondents predominantly relied on providing feedback directly on the work submitted for students to review, as indicated in Figure 10, which is often similar to the approaches taken in traditional grading. Less common practices included specific annotated rubrics, oral feedback, and self-assessment.

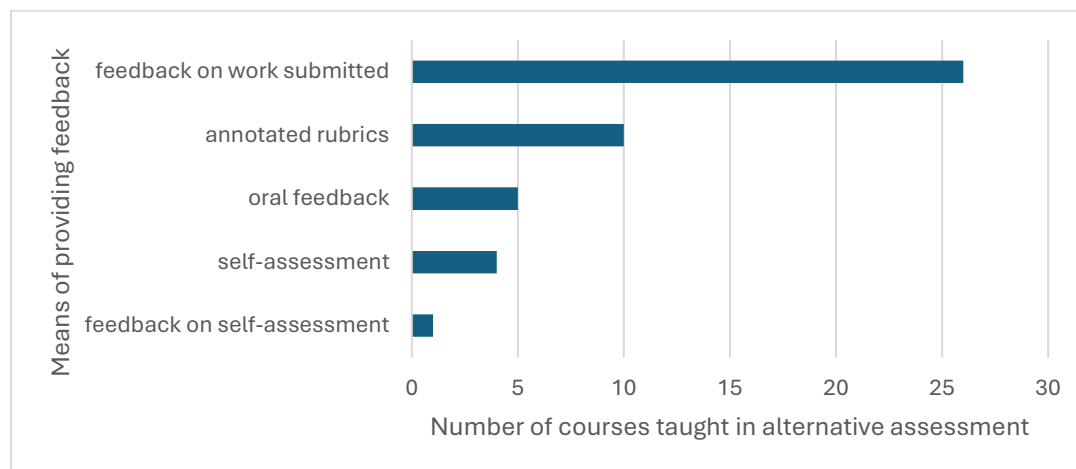


Figure 10. How feedback on student work is most commonly provided in respondents’ alternatively assessed courses.

Alternative assessment often provides some opportunity for students to respond to feedback, in some cases in an iterative form to allow for repeated opportunities to correct mistakes or solidify their demonstrated mastery. Respondents’ most common practice was to require student response within one week, although a large range of time beyond one week was commonly put into practice, as indicated by responses in Figure 11.

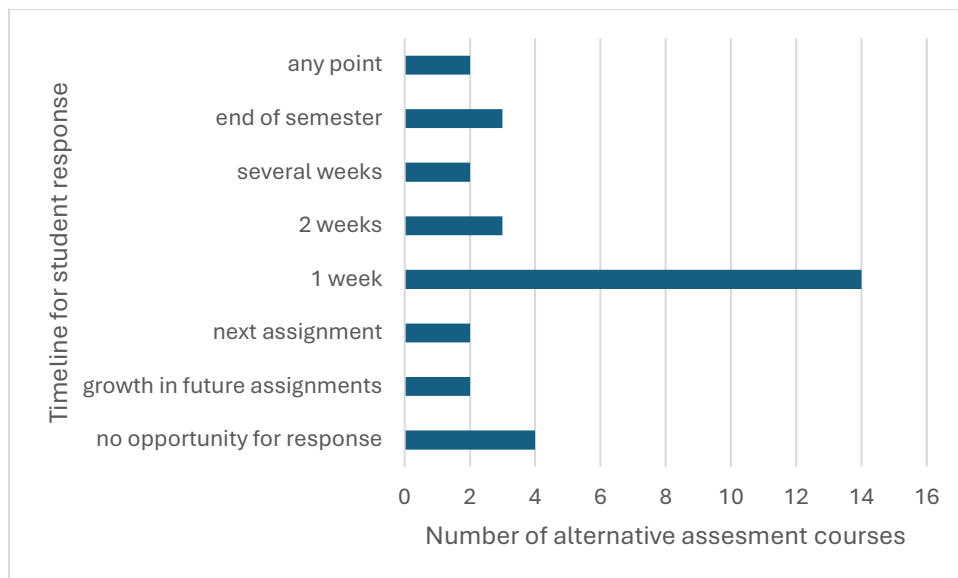


Figure 11. Different timelines allowed for student responses to be submitted in respondents' alternatively assessed courses.

Resubmission of work for additional attempts or to iteratively build and prove mastery is a common alternative assessment feature. In the respondents' classes, the most common example was to allow one resubmission, followed by either no resubmissions or and unlimited number of attempts, as indicated in Figure 12.

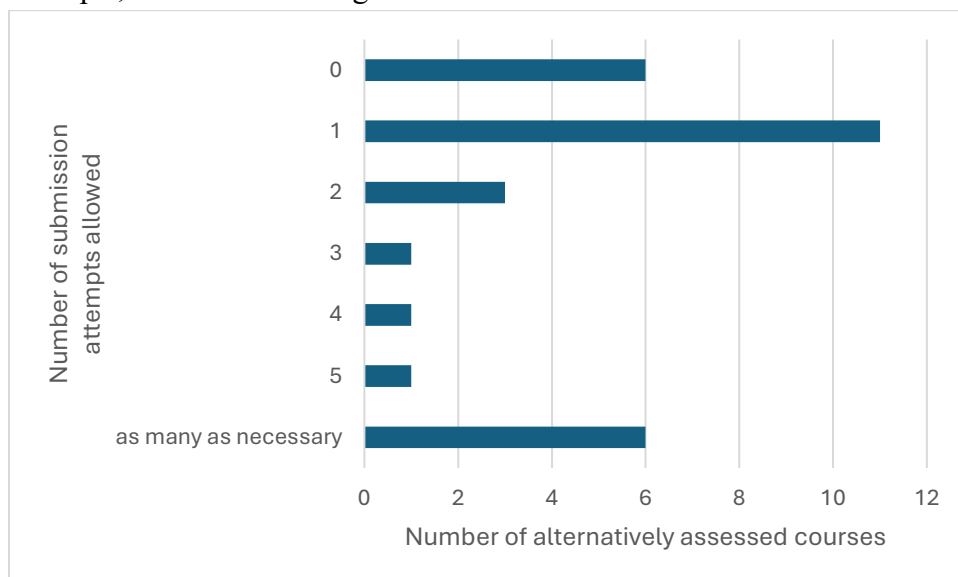


Figure 12. Number of submission attempts allowed in respondents' alternatively assessed courses.

Finally, respondents were asked how the final course grades were determined. A wide range of examples were described by the respondents, with the most frequent example being a traditional scale based on points earned, even if applied in an alternative assessment framework. Allowing students to propose their own grade with final determination by the instructor, or a combination of

methods including standards-based and specifications-based rubrics were also common, as observed in Figure 13.

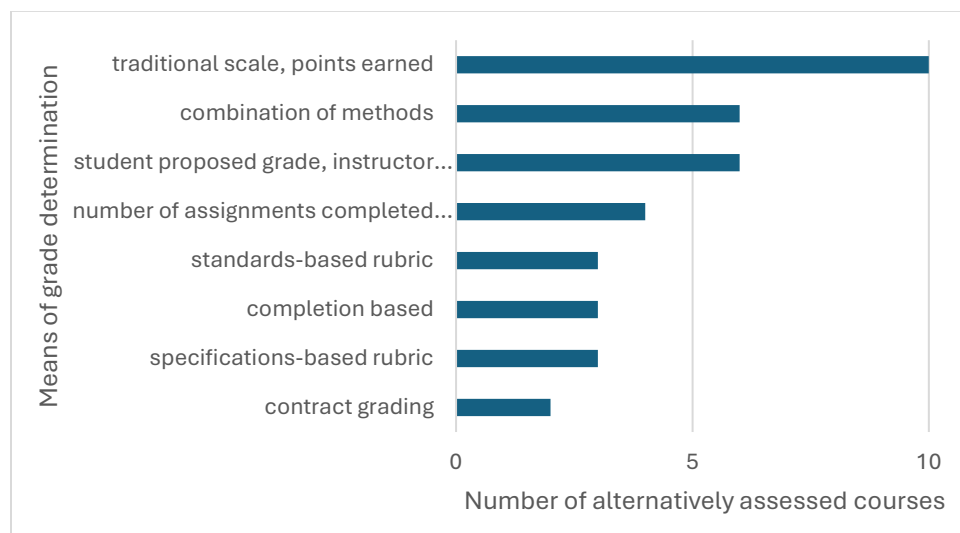


Figure 13. Grades determination methods in respondents' alternatively assessed courses.

Conclusions

From the survey effort, several trends were observed in the status of alternative assessment among chemical engineering faculty. First, alternative assessment is more frequently used by non-tenure track and/or newer faculty, suggesting that those with less long-term use of traditional grading or those whose work is primarily focused on teaching are more likely to have used alternative assessment. Second, alternative assessment is currently being used across examples of most chemical engineering courses and many additional electives, in both classroom-based and laboratory-based courses, and through a range of implementation styles as determined by respective instructors. Third, respondents observed a range of benefits, with most commonly highlighted examples being reduced student stress and a positive change in student motivation and thinking. Finally, the largest concerns in non-use of alternative assessment focus on the rigor/fairness of assessments or lack of familiarity with alternative assessment.

With a growing number of examples of alternative assessment being implemented in chemical engineering, guidance developed from successful approaches may help in providing a means for instructors to begin to implement alternative assessment; create more institutional experience, knowledge, and support for alternative assessment, with easier routes to both instructor and student buy-in; and further support evidence of strong academic standards being upheld in addition to confirming benefits for both instructors and students.

Potential limitations of the approaches taken in this survey may include self-selection in respondents, in that faculty unfamiliar with the term 'alternative assessment' or the assessment strategies associated with alternative assessment may have been less likely to complete the survey.

Non-tenure track instructors whose focus is on teaching may be more familiar with alternative assessment as well, potentially resulting in their overrepresentation in the survey respondents.

Moving forward, the survey team will continue to work to recruit respondents to complete the survey to build a larger sample size and broaden more insight into instructors' motivations, resistance, and means to support resources and approaches to potential implementation. Surveys of students and their perceptions of alternative assessment approaches have been previously conducted by individual engineering instructors with respect to their courses; a broader survey across institutions will also be considered.

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