Grading for Equity in Engineering Education: A Case Study with Implementation Examples

Dr. Jennifer Mott, California Polytechnic State University, San Luis Obispo

Jennifer Mott is an Assistant in Mechanical Engineering at Cal Poly San Luis Obispo. Her research interests include Thermal Comfort, using Team Based Learning in engineering courses and improving teaching for engineers.

Grading for Equity and Growth in Engineering Education: A Case Study with Implementation Examples

Abstract

This study explores the implementation of equitable grading practices in engineering education, focusing on Thermodynamics 2 and Thermal System Design courses. To improve student learning experiences, it is crucial to redefine conventional grading norms and place an emphasis on motivational, bias-resistant, and mathematically accurate grading techniques. Methods described here include a hybrid approach to mathematically accurate grades, a non-punitive late policy, and the incorporation of retakes and re-dos as opportunities for growth. The results indicate the successful application of these practices, addressing challenges and promoting a shift towards equitable grading. In addition to offering helpful insights into the application of these equitable grading techniques, the paper provides specific examples of how they are used in classroom environments.

Introduction and Motivation

In the ever-evolving landscape of engineering education, the quest for fair and effective grading practices has become a topic of interest. The idea of "Grading for Equity," as Joe Feldman defines it in his book of the same name from 2019, lies at the core of this author's endeavor to change their grading practices. This approach transcends traditional grading norms, advocating for practices that are not only mathematically accurate but also bias-resistant and motivational, ultimately geared toward fostering meaningful learning experiences for students. [1]

Traditional grading systems have several positive features that contribute to effective communication within the educational system. Firstly, they facilitate communication between schools, providing a standardized means of conveying a student's performance. This practice is common in higher education, streamlining the transfer of academic records. At the assignment level, traditional grading allows students to gauge their current performance by calculating their grades at any time. This transparency offers insights into their standing and prompts adjustments as needed. Additionally, traditional grading is the default in learning management systems, eliminating the need for unconventional methods to access the gradebook. Points in traditional grading are fungible, enabling students to accumulate scores in various parts of a course. [2]

However, despite these apparent benefits, traditional grading faces significant challenges that warrant attention. One of its shortcomings lies in misrepresenting learning, as grades often reflect only the maximum points available, creating a disconnection between grades and actual growth. False positives and negatives are common occurrences, leading to an inaccurate portrayal of a student's learning level. The use of numerical points to evaluate student work is also a limitation, as grades are categorical data representing quality rather than the result of a measurement. This poses challenges when attempting to apply

mathematical calculations, rendering grades less useful than more conventional data sets. [2]

Furthermore, traditional grading systems are criticized for their inequitable nature and inherent biases. [1, 2] The emphasis on points, partial credit, and averaging tends to favor students who quickly grasp or already know the material due to their educational or family background. This approach can inadvertently reflect a student's environment and behavior rather than their actual knowledge. Traditional grading practices are demotivating, particularly with a permanent penalty incurred by averaging early attempts. The one-and-done approach to assessments discourages students from engaging in a feedback loop, resulting in a significant number of exams being discarded. Additionally, students who receive grades on an activity, even with feedback, exhibit lower intrinsic motivation for subsequent tasks. [2] The common practice of curving grades to fit a fixed distribution, such as a normal curve, is considered demotivating and inequitable. [2] Overall, traditional grading is associated with unhealthy student-faculty relationships, academic dishonesty, and inefficiencies in faculty time utilization. [2]

Grading for equity challenges the status quo, offering a departure from conventional grading practices that often rely on comparative assessments and standardized metrics. At the heart of any instructional or course policy is the desire to facilitate student learning and support their growth. The alternate grading policies discussed in this paper are aimed at further improving student learning, motivating students, reducing stress, and reducing cheating.

Research has shown three practices that improve student learning: retrieval practice, spaced repetition, and interleaving. Retrieval practice involves recalling information without prompts or materials, leading to improvements in long-term memory, exam performance, and knowledge transfer. [2,3] Spaced repetition involves repeated review sessions of content spread out over time, with the opposite being massed practice, e.g., cramming before an exam. [4] Interleaving, or mixed practice, involves reviewing or studying different topics in the same practice or review session, benefiting learning and performance in various forms and settings. [5] Feedback loops in alternative grading systems support these practices, encouraging students to revisit and reflect on past work, study new topics, and reassess older ones simultaneously. [2]

According to Clark and Talbert, alternative grading practices promotes student motivation by setting clear standards and encouraging reassessment until the standards are met. Traditional grading can lead to partial understanding without real underlying competence. Giving students the ability to choose their own path for how and when they assess supports autonomy. [2] In addition, alternative grading can improve learning and motivation, support student well-being, and promote student-centered learning environments. Alternative grading enables instructors to respond effectively to student needs by framing progress in terms of clear standards. [2] Finally, alternative grading can reduce student stress. [6, 7]

Achievement goal theory suggests alternative grading systems may not lead to greater academic dishonesty. [8] The theory divides competence into mastery goals (improvements in personal material) and performance goals (superior performance compared to others). Performance goals, especially performance-avoidance goals, often encourage "maladaptive behaviors" (cheating) as students try to avoid appearing incompetent or looking bad. [8] Research suggests that students are less likely to cheat when they hold mastery goals or perceive a mastery goal structure. [8] Practical advice from achievement goal theory includes providing opportunities for remediation and retaking exams or rewriting assignments, as well as clear standards and reassessment without penalty. [9] Other research confirms the theoretical expectation of reduced cheating, even in online classes or unproctored take-home exams or quizzes. [6]

Alternative grading is often criticized for promoting grade inflation, where students are awarded higher grades for work that would have received lower grades in the past. However, the actual results are not always clear. According to Clark and Talbert, alternative grading frequently results in higher average grades, with some instructors reporting a significant improvement over classes that use traditional grading. More students pass alternatively graded courses, and the percentage of students earning a D or F or withdrawing drops. Grade distributions may become bimodal, with more students earning higher grades and more students earning lower grades. The increase in grades is often due to clear standards and reassessments, which remove penalties for early struggles, making a student's final grade a more honest indicator of their actual level of understanding. [2] Grade inflation does not simply mean "higher grades" or even higher grades than what students may have earned in the past. It is more useful to define it as "higher grades without better learning." [2] In an alternative grading system, grades are directly tied to what students learn, and reassessments make those grades more accurate.

The primary objective of this paper is to navigate the intricacies of implementing some of these equitable grading policies. A case study is presented that delves into the practical application of these equitable grading principles within the context of two courses: Thermodynamics 2 and Thermal System Design. Both courses are required for mechanical engineering majors at a large, primary undergraduate public university.

The following sections will describe the dimensions of equitable grading as laid out by Feldman [1], then use descriptions of examples and classroom experiences to provide valuable insights for educators seeking to optimize their grading strategies and promote more effective and equitable learning experiences.

Dimensions of Equitable Grading

In the pursuit of equitable grading, the implementation of grading practices that are mathematically accurate, bias-resistant, and motivational is paramount. [1] Joe Feldman's three dimensions not only rethink conventional grading standards, but they also pave the way for creating an environment where learning takes precedence over traditional metrics. In addition, the equitable grading policies include the practice of making grading transparent to students, known as "Lifting the Veil". [1]

Mathematically Accurate

The goal of mathematically accurate grades is that they correctly describe a student's level of academic performance, e.g., are not comparative to other students' scores, as in a curve or grade adjustment, and weight the student's most recent achievements. One option for mathematically accurate, equitable grading is the adoption of the 0–4 grade scale, aligned with standards-based grading principles. This scale, as detailed in Feldman's framework, emphasizes success, simplicity, and reduced susceptibility to error and variance. [1] The 0 to 100 scale overemphasizes failure by having 60% of the scale dedicated to failing and 40% to passing scores. The 0–4 grade scale has equal divisions for each grade, making it more equal for grading and more mathematically accurate. [1]

Bias-Resistant

Equitable grading contends that grades should reflect learning, not behavioral nuances. [1] One transformative practice towards this goal is the acceptance of late work without penalty. Rooted in the belief that penalizing late submissions hinders learning, this approach encourages students to focus on understanding the material without the fear of a diminishing grade. According to Feldman, "when grades are lowered for work submitted late, many students, rather than submit work past the deadline for less credit, will choose to stop working on the assignment after the deadline has passed and will stop learning. Other students may resort to copying to meet the deadline, in which case they'll meet the deadline but won't have learned [anything]." [1] By providing students with flexibility in meeting deadlines, the focus is shifted towards the quality of work rather than adherence to strict timelines. Therefore, by accepting late work without penalty, grades are more accurate reflections of students learning and not their behavior.

Motivational Strategies

Equitable grading practices should be motivational, encouraging students to strive for academic success, persevere, accept struggles and setbacks, and gain critical lifelong skills. Students should be motivated to learn, not just earn that passing grade (or not get a failing grade). Allowing retakes and re-dos emerges as a motivational strategy, acknowledging that learning is an iterative process. Allowing retakes and re-dos for assignments offers students opportunities to learn from their mistakes and improve their understanding. By providing students with the opportunity to correct errors and misunderstandings, the grading process becomes a mechanism for growth and increased competence. [1]

Transparency in Grading

Equitable grading practices advocate for transparency, making academic expectations explicit, and empowering students. Using rubrics becomes a powerful tool in this endeavor. As Feldman states, "Traditional grading can seem opaque and arbitrary. Although teachers have conceptions of what they are expecting from student academic performance, these ideas are often [unclear] and stay inside the teacher's mind,

inadvertently concealing what it takes to succeed and disempowering students. When academic expectations are hidden, grading privileges students whose families have had more access to those expectations, either from prior success in school or in other institutions of power." [1] Strategies such as the use of rubrics and standards-based scales empower students by clearly defining expectations and performance levels, enhancing their self-identification of areas for improvement.

Logistics and Discussion of Alternative Grading Course Policies

The section that follows explains the logistics of implementing various alternative and equitable grading policies. Because the university where these policies were implemented uses Canvas as its Learning Management System (LMS), implementation details will be based on Canvas features. [10] These features may be available in other LMS programs. The discussion is based on the instructor's experience implementing the various policies and the instructor's personal assessment of how well they worked.

Mathematically Accurate Grades: A Hybrid Approach

The 0–4 grade scale, as prescribed by Feldman, was implemented in Thermal System Design during the Spring of 2022. The scale, as shown in Table 1, was designed to be more aligned with standards-based grading and to provide a more accurate representation of student success. However, difficulties in computing final grades arose, prompting the adoption of a hybrid approach that combines aspects of both traditional grading and standards-based grading.

Table 1. The 0–4 point scale aligned with standard based grading.

Grade	Points	Meaning
F	0	Insufficient Evidence - nothing turned-in, skipped assignments.
D	1	Not yet met standards - major mistakes, little to no correct process steps.
C	2	Approaching Standards - has some correct process steps and is on the right track but makes major errors.
B	3	Meeting Standards - has correct process and correct answers. May have minor mistakes.
A	4	Exceeding Standards - must go above and beyond meeting standards or is perfect

While the instructor liked the idea of grading on standards and has kept it as part of the grade, it was difficult to compute the grade, especially the final grade, solely on standards. For starters, the standard grades should be averaged rather than expressed as a percentage or as a percentage of a total. Canvas will only calculate the percentage of a total and not average assignment grades in a rubric. This method of calculating grades made them more difficult to understand, not easier. For example, if a student receives one 4, two 3's, and one 2 on a four-standard assignment, the average grade is 3, which is a B. However, the percent grade is 4+3+3+2=12, then 12/16=0.75, resulting in a C grade. The student notices a C in the grade book and becomes concerned about their grade, but it is

incorrect. Automatic letter grades were turned off in Canvas, but even if students knew the scale is different than traditional, it did not help that the student's immediate reaction to seeing a 75 and remembering that they have a B, and not a C. Part of the purpose of the new grading is to make it less stressful not more, so this solution was not utilized. Furthermore, rather than using Canvas to calculate grades, determining the final grade required downloading all grades and performing the calculation in Excel. Finally, assigning final grades became difficult because converting from the 0–4 scale to letter grades proved more difficult than the instructor had anticipated, and the grades did not seem to be "less prone to error," as Feldman had promised. [1] So far, the solution has been to abandon the 0–4 scale grading system in favor of a hybrid of traditional and standards grading, as described further below.

Bias-Resistant Practices: Redefining Timelines for Learning

A non-punishment late policy for both thermodynamics and thermal system design was initially implemented in Spring 2021 and has since been formalized and adjusted as needed in each term. As Feldman says, and the instructor agrees, "it's better to produce high-quality work submitted after the deadline than to cut learning short." [1] Furthermore, the instructor discovered that the quality of the work improved, and students asked more questions to better understand and learn the material. Accepting late work reduces bias in grading by not penalizing students for taking longer to learn or penalizing students who need the extra time to work because of personal issues, such as having a part-time job or family obligations.

The late assignment policy accommodates different assignment types and allows for effective communication, ensuring transparency and fairness. Flexibility in late assignment policies was tailored to the level of the assignment, acknowledging the diverse needs of students.

Late Assignment Policy

- Quizzes—need to be done on time; no make-up; for absences due to academic activities, let the instructor know before the quiz.
- Applications and other assignments—1 to 2 days late, email the instructor; more than 2 days, email the instructor and tell them when you expect to get it done.
- End Assessments—you must email the instructor and clear it with them first; make and communicate a plan of when it will be finished.

Quizzes have the least impact on the grade and, thus, the least room for variation. They are also formative for the instructor to ensure students understand material as the course progresses, so a late quiz would not help much with "just-in-time teaching." Applications are in-class and homework assignments, so they have the most leeway because this is where students will make the most mistakes and learn from them. End assessments are take-home exams with stricter grading deadlines. While they are permitted to be late, they must communicate with the instructor more frequently to be accepted as late. Students must communicate with the instructor about their assignments in all cases, just as they would with their boss in a professional setting.

The logistics of late assignments are accomplished through Canvas—all assignments are submitted and graded through Canvas. Since Canvas notifies the instructor (and the course grader) when there are items to grade, it is no problem to go back and grade late items or even catch them in the middle of grading the assignment. Because of the online submissions, there is no longer the need to track down paper assignments, and due dates and times can be set at any time of day, which are typically set at midnight. This, in turn, leads to students asking the instructor questions about the assignment after class on the day it's due, when they still have time to finish it and turn it in on time, which they would not have been able to do if it were a paper turn-in at the start of class.

This strategy has been one of the most successful in the author's classes because of the ease of using Canvas for collecting and grading assignments, as well as the benefits to students' learning. Even if they don't use it, most students seem to appreciate a generous late policy. Many students expressed their thanks directly to the instructor for the late policy. Students express their thanks for understanding during stressful times during the term or when dealing with illness or family emergencies. Though some students have expressed their dissatisfaction with the late policy; these are typically students who do not require work extensions or who learn faster than their peers and do not require the extra time. The late policy not for these students, but for those who are struggling with the material and need that extra time to learn the material and do the work, those who need that part-time job to pay for college and an extra day for homework means they turn in a complete assignment rather than one half completed, and those who have family obligations that require them to give up study time to care for a sick child, sibling, parent, or spouse. Accepting late work without penalty is an equitable teaching practice because of our students' diverse needs.

Motivational Strategies: Retakes and Re-Dos as Opportunities for Growth

As an understanding instructor, it is important to relieve students' stress about grades so that they can focus on learning the material while knowing that the appropriate grade will follow. As a result, to encourage students to learn from their mistakes, assignment re-dos are allowed.

All quizzes in the author's courses have two opportunities to take and learn from mistakes in between quiz submissions. Applications and homework assignments also have multiple attempts possible. If a student wishes to resubmit, they should consult with the instructor about what they need to change and redo the work. The redo/retake policy is more formal for exams and end-of-course assessments. For in-class exams, the author has given a re-do exam assignment and midterm wrapper. For the take-home end-of-course assessments to be allowed a re-do on the assessment, students must talk to instructor about their mistakes and how they plan to correct them.

Grading resubmitted work is easy because of Canvas submissions and grading. The instructor can see the previous grade and regrade only the sections where the student lost points previously. However, since switching to take-home exams, students have more

time to work on problems and a higher success rate, so the re-grading load has been reduced. Allowing re-dos, like the late policy, allows students to ensure that their best work is graded and accurately represents their abilities.

Transparent Grading with Rubrics and Standards as Empowering Tools

Grading transparency is achieved using rubrics and standards-based scales. The incorporation of rubrics into the Canvas grading process gives students a clear understanding of what is expected of them. "Rubrics are a powerful way to make expectations transparent," says Feldman. "Effective rubrics are detailed, clear, and user-friendly, allowing students to evaluate their own performance." [1]

The author has been using rubrics to grade for years, but it wasn't until they began using Canvas and the tool "speed grader" to grade that they began posting their rubrics for students to see. Rubrics have proven to be extremely effective in the classes. In addition to simplifying grading in Canvas, rubrics are published with each assignment so that students are aware of the expectations for their success. Before submitting an assignment, students will check to see if they have addressed a specific item on the rubric. Students will also discuss how to improve their work for the next assignment using the graded assignment and the corresponding rubric. Figures 1 and 2 show examples of course rubrics.

Even though the 0--4 grade scale did not work for determining the total grade in Thermal System Design, the instructor used the standards developed for that course and developed standards for Thermodynamics 2 so that students received grades in both the traditional way—points based on correctness of work—and based on the standards and 0-4 grade scale. The standards component of the grade assesses students' progress toward meeting the course's standards. Figures 1 and 2 above show examples of how those standards are incorporated into the rubrics. Students frequently ask the instructor how to move up in the standards, that is, what they need to do to demonstrate that they have met the standard at a higher level—exactly what we would hope students would do to improve their learning and performance.

The standards, or outcomes, as they are known in Canvas, can be uploaded from a CSV file to the "Outcomes" section of courses in Canvas, along with the grading scale. This upload makes it extremely simple to create and import all the course outcomes. They are also easily transferable to other Canvas courses for future terms. The standards grading scale is the same as discussed above in the 0–4 grade scale section. Figure 3 depicts an example of how the outcome grade book looks. The class average for each outcome is shown across the top; each column represents one outcome, and each row represents an individual student. The results are color-coded, making it easy for instructors to see which standards students haven't met yet and where potential problems may exist in the course.

Criteria	Ratings					Pts
Handwritten derivation	20 pts Correct	15 pts Minor errors	10 pts Major Errors	5 pts half hearted attempt	0 pts missing	20 pts
Solution	20 pts Correct, including units	15 pts minor errors	5 pts something but no solution		0 pts No Marks	20 pts
Analyze combustion reactions using the first law of thermodynamics and conservation of mass using the tables and EES threshold: 3.0 pts	4 pts Exceeding Standards	3 pts Meeting Standards	2 pts Approaching Standards	1 pts Not yet Met Standard	0 pts Insufficient Evidence	4 pts
Balance combustion reactions threshold: 3.0 pts	4 pts Exceeding Standards	3 pts Meeting Standards	2 pts Approaching Standards	1 pts Not yet Met Standard	0 pts Insufficient Evidence	4 pts
Evaluate properties of combustion reactant and products threshold: 3.0 pts	4 pts Exceeding Standards	3 pts Meeting Standards	2 pts Approaching Standards	1 pts Not yet Met Standard	0 pts Insufficient Evidence	4 pts
EES Solution	10 pts Correct, including units	7.5 pts minor errors	2.5 pts something but no solution		0 pts No Marks	10 pts
						Total Points: 62

Figure 1 Rubric for an application (homework) problem from Thermodynamics 2 for the topic of combustion. The criteria that have a "bulls' eye" are learning objectives and standards for the assignment.

Criteria	Ratings					Pts
Solution	10 to >5.0 pts Solution is correct and complete		5 to >0.0 pts Solution has minor errors or is correct but missing aspects		0 pts No submission.	10 pts
Discussion	10 to >5.0 pts Original submission that fulfills discussion criteria		5 to >0.0 pts Original submission that partially fulfills the discussion criteria.		0 pts No submission or is unoriginal	10 pts
Draw cash flow diagrams. threshold: 3.0 pts	4 pts Exceeding Standards	3 pts Meeting Standards	2 pts Approaching Standards	1 pts Not yet Met Standard	0 pts Insufficient Evidence	4 pts
Evaluate thermal systems based on life-cycle economics. threshold: 3.0 pts	4 pts Exceeding Standards	3 pts Meeting Standards	2 pts Approaching Standards	1 pts Not yet Met Standard	0 pts Insufficient Evidence	4 pts
Use the correct economic factors to calculate present cost/benefits threshold: 3.0 pts	4 pts Exceeding Standards	3 pts Meeting Standards	2 pts Approaching Standards	1 pts Not yet Met Standard	0 pts Insufficient Evidence	4 pts
Evaluate and defend design choices from an econonmic standpoint. threshold: 3.0 pts	4 pts Exceeding Standards	3 pts Meeting Standards	2 pts Approaching Standards	1 pts Not yet Met Standard	0 pts Insufficient Evidence	4 pts
						Total Points: 36

Figure 2 Rubric for an application (homework) problem from Thermal System Design for the topic of engineering economics. The criteria that have a "bulls' eye" are learning objectives and standards for the assignment.

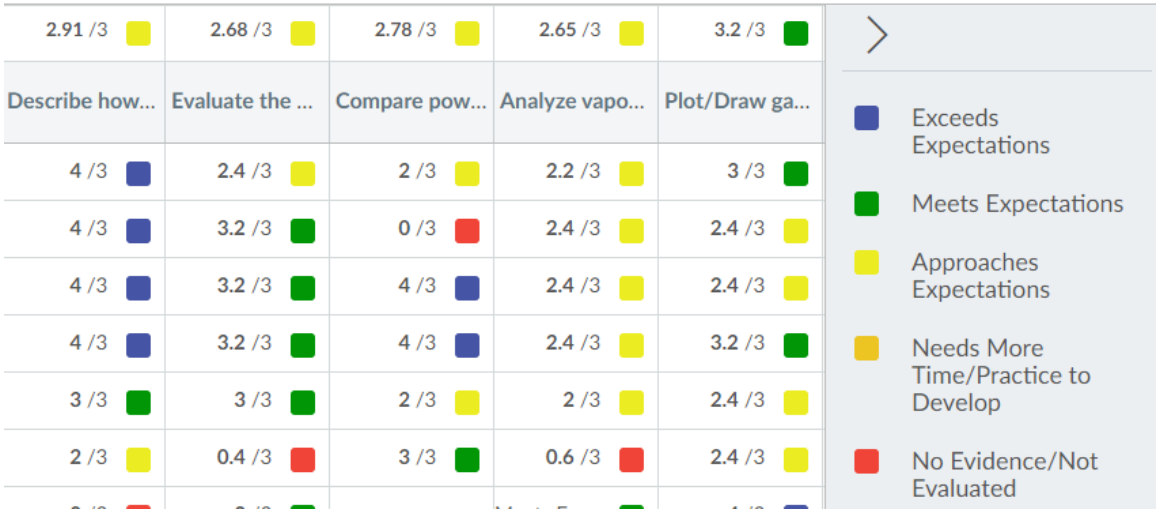

Figure 3 Example from Canvas "Learning Mastery Gradebook" based on the outcomes grading. The color-coded scale is shown on the right.

Instructor Thoughts

Certainly, the first feedback that comes to mind for most faculty is “How much time is this going to take me?” which is a valid question and concern. Setting up the rubrics and course policies does not take much time, but rather the logistics and moving parts of working with the students as they request extensions. The amount of time spent keeping track of the students' requests increases as the size of the class increases. For this instructor and author's experience, the class size is average at 35 and maximum at 42, depending on the course. The instructor has taught up to three sections during one term for up to 105 students. The author advises asking the students to include the date and length of the extension in the comments of their submissions to keep track of the student emails. Canvas automatically marks submissions as late, and students can add a comment after their submission indicating they have permission for the late assignment. This puts the responsibility on the students, not the instructor, to keep track of due dates.

The second logistics time sink is the time for the instructor and graders to go back and regrade or grade late assignments, which could be significant, depending on the class and the number of students asking for extensions. For this instructor's and author's experience, this has not been a huge issue. The number of assignments turned in and needing individual grading is lower compared to some other classes—typically two to three assignments per topic or module. Grading is usually not started until one to two days after the due date, so grading late assignments does not take any extra time since they are usually submitted before grading begins. Going back and re-grading re-dos does take extra time, but so far, the instructor has seen less than 10% of the students need to use this policy. Knowing that they can re-do the assignment gives students the peace of mind that they will not be penalized for not understanding something and, in this instructor's opinion, encourages them to ask questions and figure it out before the due date, not after it has been graded. All application (homework) assignments are allowed to be discussed among students. This instructor has witnessed students explaining and

helping colleagues to understand and do the work, which contributes to the low number of re-dos needed and higher quality submissions.

The late policy has also resulted in high quality submissions. Students know that they can take an extra day or even a few hours to finish the assignment to the highest quality. Many emails asking for extensions include a statement of what the student is still struggling with and the desire to talk to the instructor at the next available office hour. These interactions with the student, including the discussion of the confusing material, have also contributed to higher quality assignments. Giving immediate feedback on assignments can be difficult, but if we can have these conversions before the submission, learning outcomes can be improved. For example, a student struggling with understanding a complex concept can request an extension to delve deeper into the material and receive clarification from the instructor. By discussing their challenges and seeking guidance prior to submission, the student can produce a more complete and thorough assignment.

Another valid concern is students "taking advantage" of the policies, resulting in significant procrastination and falling behind in the class. To address the first point of "taking advantage," it depends on one's point of view of what it means to take advantage of a late policy. Certainly, this instructor wants the students to use the late policy when needed, especially for times when family emergencies or illness occur. This is exactly why these policies are in place. The students' gratitude for the late policy, which helped them balance personal and academic obligations, convinces this instructor that it is worthwhile. The instructor has had a couple of students who underestimate the time required to keep up with the course and do get significantly behind in the course by counting on being able to turn in assignments late. This is a good lesson for these students in time management. When this situation occurs, the instructor has a conversation with the student about what is happening and why. Together, they come up with a plan to get the student back on track. For example, a student who is falling behind may meet with the instructor to discuss their struggles and create a plan to catch up. The instructor may have the student come to office hours to work on practice problems while they are present, allowing for immediate feedback and guidance. This hands-on approach can help the student develop better time management skills and improve their understanding of the material. The instructor does need to keep a pulse on the class, and identifying struggling students early on improves the overall learning and reduces students falling too far behind. However, in some cases, even with early intervention and personalized attention, a student may continue to struggle due to external factors such as family issues or health concerns. In these situations, it may be necessary for the instructor to refer the student to additional support services within the school or community to address these underlying issues.

Finally, there are of course limitations to late submission policies. For example, the instructor does not have infinite time to be continuously re-grading assignments, and they themselves have deadlines for course grade submission. The author and instructor had tried to balance the limitations of the instructor’s time and own deadlines and the course policies. The instructor believes that for the students at their particular university, the

balance works, and different instructors may need to find a different balance. In addition, the instructor is up front with the students about the end of term deadlines and the instructor's own limitations. The instructor has always gotten positive feedback and understanding from the students on these issues. For example, if a student is struggling with personal issues and needs an extension on an assignment, the instructor is willing to work with them to find a solution that allows the student to succeed while still maintaining academic integrity. This approach fosters a supportive and understanding learning environment where both students and instructors feel valued and respected.

Conclusions

In the ever-evolving landscape of engineering education, the quest for fair and effective grading practices has led this author to a reevaluation of traditional grading norms. According to Joe Feldman, the idea of "Grading for Equity" goes beyond conventional approaches, advocating for mathematically precise, bias-resistant, and motivational grading practices that put a priority on meaningful learning experiences for students. It is acknowledged that traditional grading has certain benefits, such as improving communication between schools and offering transparency at the assignment level. However, there is a need to reevaluate grading methodologies because of the problems with traditional grading, such as its tendency to misrepresent learning, dependence on numerical data, and inherent biases.

Based on Feldman's framework, the paper explored three aspects of equitable grading: mathematically accurate, bias-resistant, and motivational strategies. The logistics and discussions of different grading policies, such as a hybrid approach to mathematically accurate grades, redefining learning timelines through non-punishment late policies, and seeing retakes and re-dos as chances to grow, provided an overview of the challenges and successes encountered in real-world implementation.

To address the problems with traditional percentage scales, mathematically accurate grading prioritizes a 0–4 grade scale that is in line with standards-based grading principles. The adoption of a 0–4 grade scale, in alignment with standards-based grading, is aimed at emphasizing success, simplicity, and reduced susceptibility to error and variance. While this approach offered insights into grading based on standards, challenges arose in computing final grades, leading to a hybrid approach.

Equitable grading is based on inspiring students to learn and promoting a growth mindset. Bias-resistant practices promote learning over penalizing behavior, rather than punitive approaches to late submissions. Retakes and redos are acceptable and accepting that learning is an iterative process is one of the motivational techniques. Assessments become chances for growth and learning when retakes and redos are permitted for quizzes, homework, and exams. The structured policies for different assessment types, combined with the ease of implementation through Canvas, create an environment where students are motivated to correct errors, deepen their understanding, and actively engage in the learning process. By outlining expectations clearly, the transparent grading process—achieved using standards-based scales and rubrics—empowers students.

Grading turns into a collaborative process that motivates students to discuss their performance in depth and identify areas for growth on their own. The standard of student work and their continued mastery-focused focus are two concrete indicators of these motivational strategies' effectiveness.

References

[1] J. Feldman, *Grading for Equity*. Corwin Press, 2018. [Online]. Available: http://books.google.ie/books?id=ORhoDwAAQBAJ&printsec=frontcover&dq=Grading+for+Equity&hl=&cd=1&source=gbs_api

[2] D. Clark and R. Talbert, *Grading for Growth*. Taylor & Francis, 2023. [Online]. Available:http://books.google.ie/books?id=TA_JEAAAQBAJ&printsec=frontcover&dq=Grading+for+Growth&hl=&cd=1&source=gbs_api

[3] H. L. Roediger and A. C. Butler, "The critical role of retrieval practice in long-term retention," *Trends in Cognitive Sciences*, vol. 15, no. 1, pp. 20–27, Jan. 2011, doi: 10.1016/j.tics.2010.09.003.

[4] S. K. Carpenter, N. J. Cepeda, D. Rohrer, S. H. K. Kang, and H. Pashler, "Using Spacing to Enhance Diverse Forms of Learning: Review of Recent Research and Implications for Instruction," *Educational Psychology Review*, vol. 24, no. 3, pp. 369–378, Aug. 2012, doi: 10.1007/s10648-012-9205-z.

[5] K. H. Mayfield and P. N. Chase, "THE EFFECTS OF CUMULATIVE PRACTICE ON MATHEMATICS PROBLEM SOLVING," *Journal of Applied Behavior Analysis*, vol. 35, no. 2, pp. 105–123, Jun. 2002, doi: 10.1901/jaba.2002.35-105

[6] J. Elsinger and D. Lewis, "Applying a Standards-Based Grading Framework Across Lower Level Mathematics Courses," *PRIMUS*, vol. 30, no. 8–10, pp. 885–907, Oct. 2019, doi: 10.1080/10511970.2019.1674430.

[7] D. Lewis, "Student Anxiety in Standards-based Grading in Mathematics Courses," *Innovative Higher Education*, vol. 45, no. 2, pp. 153–164, Dec. 2019, doi: 10.1007/s10755-019-09489-3.

[8] J. Andrew and A. McGregor. "A 2× 2 achievement goal framework Holly, "Journal of personality and social psychology 80 no," 2001, [Online]. Available: https://psycnet.apa.org/record/2001-16719-011

[9] E. M. Anderman and A. C. Koenka, "The Relation Between Academic Motivation and Cheating," *Theory Into Practice*, vol. 56, no. 2, pp. 95–102, Mar. 2017, doi: 10.1080/00405841.2017.1308172.

[10] "Canvas LMS," *Instructure Community*. https://community.canvaslms.com/t5/Canvas-LMS/ct-p/canvaslms