



A Consideration of Gradeless Learning in Higher Education

Adan Amer¹, Gaganpreet Sidhu², Seshasai Srinivasan^{3*}

¹²³ W Booth School of Engineering Practice and Technology, McMaster University, Hamilton, Ontario, Canada

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*Corresponding Author

Email address:

ssriniv@mcmaster.ca

ABSTRACT

This article presents a brief overview of the purpose, implementation, and criticisms of the typical graded system 'used by most schools worldwide to assess students' academic performance. Letter and numerical grades serve many purposes, such as motivating students and allowing teachers or parents to track progress, yet this tool is quite unreliable for measuring knowledge acquisition. The overuse of grades to measure student success also impedes intrinsic learning outcomes, such as discovering interests or developing skills essential for transforming post-secondary students into lifelong learners. In contrast, gradeless learning systems that emphasize the application of knowledge and high-quality feedback can improve 'students' well-being and overall learning outcomes. Despite these benefits, switching away from grades is a tumultuous one given that students rely on them for motivation to perform well in school. Hopefully, implementing gradeless learning on a program or course level will be the first step in achieving this paradigm shift.

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1. INTRODUCTION

Letter grades and percentage scores have existed in all levels of education for over a century to organize and track students' academic performance and progress (Anderson, 2018; McMorran et al., 2017; Schinske & Tanner, 2014). While the purpose of a grade varies between classrooms and institutions, Anderson (2018) narrows it down to three goals: 1) to motivate students, 2) to keep teachers informed about the effectiveness of their instruction style, and 3) to communicate the 'students' learning progress to multiple audiences like parents and policymakers. Among the three purposes, motivating students is paramount in justifying the graded system. It is a common attitude within the educational system that high grades reward hard work and successful studying, while low grades are a punishment for poor efforts (Gold et al., 1971). As per Walvoord and Anderson (2011), the power of grades to motivate and reinforce the learning process heavily depends upon the teacher's skill set. Yet, for as long as grades have been ingrained in the educational system, scholars have criticized their utility in producing actively engaged and curious students who are ready to enter the workforce (Anderson, 2018; McMorran et al., 2017; Schinske & Tanner, 2014, Walvoord & Anderson, 2011).

A major concern about the graded system is that letter and number grades are quite unreliable (Anderson, 2018). For instance, grades are subjective and dependent upon the person assigning them (Pippin, 2014), particularly in essays or written response tests. Even in Multiple-Choice assessments, there is a potential to falsely indicate a student's level of understanding (Schinske & Tanner, 2014). The reliability of grades was questioned over a century ago when Starch and Elliot (1912) gave the same English paper to 142 teachers and had all of them grade it. They found that the grades for the same paper had varied from 50% to 89% (Starch & Elliott, 1912). Almost 100 years later, Brimi (2011) replicated the same study by providing a rubric to 90 teachers and training them for seven days on how to properly use the rubric before asking them to grade the same essay. Similarly, the assigned grades in Brimi's study ranged from 50% to 96% (Brimi, 2011). Despite the use of a rubric, used to standardize the evaluation process, the grades assigned to the same piece of written work varied considerably and depended heavily on the opinion of the evaluator. Given that grades play a significant role in a student's admission in a college or university, setting up the trajectory for the rest of their academic journey, this level of unreliability is concerning (Pippin, 2014).

The graded system has also garnered criticism for its ineffectiveness in attaining the desired learning outcomes, and its negative impact on the student's well-being. In socio-ethnic environments, placing a great value on achieving high marks, students commonly associate their marks to their worth rather than just measuring their academic progress (Pippin, 2014). This attitude has led to a steep increase in stress, and tragically, students have ended their own lives upon receiving low grades (Brilleslyper et al., 2012; Kohn, 2011; McMorran et al., 2017). The overemphasis on grades has also harmed 'students' learning attitudes and instilled a fear of failure or the penalty of low scores if they do not study. This has taken away the intrinsic reasons for learning such as discovering interests and developing skills (Anderson, 2018; McMorran et al., 2017; Schinske & Tanner, 2014). Several studies have demonstrated that students are motivated by grades and percentage rewards instead of the learning process itself. Consequently, this shift in focus undermines the goals of education, such as fostering the art of scholarly inquiry and developing life-long learning skills (Brilleslyper et al., 2012; Jacobs et al., 2014; Kohn, 2011; Malam & Grundy-Warr, 2011; Pippin, 2014)

2. GRADELESS LEARNING

Avoiding quantitative grading is a potential alternative to measure students' academic progress. For example, every assessment in the course could be structured on a Pass/Fail system, and the final grade on the course could be recorded as a 'Pass' or 'Fail' on a transcript. Qualitative rubrics determining the skills required to pass a course could be defined in assessing the 'student's progress as pass or fail. Thus, the student receives credits for passing the course and there is no credit when they fail the course. Further, the student's Grade Point Average (GPA) is not calculated. One could also incorporate a hybrid system that allows students to choose between having a letter grade or a Pass/Fail on their transcript at the end of the semester based on what they believe is advantageous. The gradeless system has varying purposes depending on the institution implementing it. Some of the most notable goals of employing gradeless assessments with detailed qualitative feedback on student performance are: (1) to ease the cognitive load on students as they transition into higher education, (2) to improve students' well-being, (3) to encourage students to undertake exploratory learning in their courses, (4) to promote collaborative learning skills, and (5) to reduce the competitive feeling among peers (Bloodgood et al., 2009; McMorran et al., 2017; Robins et al., 1995).

Globally, several prominent institutions have adopted gradeless learning with relative success (McMorran et al., 2017). In the United States, the Massachusetts Institute of Technology uses a Pass/No Record system for all first-year students while the Stanford 'University's School of Medicine evaluates all MD students with a Pass, Fail, or Incomplete score. Evergreen State College removed letter grades and solely employed narrative evaluations for their students. In the United Kingdom, the University of Sussex requires first-year students to have a Pass (40% and above) in all courses to continue to the second year. Additionally, the National University of Singapore implemented a Pass/Fail grading for all first-year students in the first semester. In this implementation, choosing a grade affects their GPA, while the other options do not. Finally, Lund University in Sweden utilizes grading scales such as Pass/Fail or Pass with Distinction/Pass/Fail for all students.

In addition to gradeless learning implementation at a school or a program level, numerous examples of professors applying this framework to individual courses despite being embedded in a grade-dependent institution. For example, McMaster University's Software Engineering Technology Program has implemented the Residency model of education in which the students spend 13 weeks acquiring certain skills and competencies pertaining to a certain subject. During this period, the students are repeatedly assessed for the desired competencies and are given detailed qualitative feedback to help improve their skills. Upon successfully achieving the competencies, they receive a "'Pass' grade that helped them earn the credits for the course. While the structure of assessments varies between the courses, they share a common grading scheme in the individual assessments in which a student's work may be marked as satisfactory (S), unsatisfactory (U), or exceeds expectations (E). For example, a typical course would have a collection of assignments, such as a set of short projects, a midterm test, and final portfolio. The assignments are released two weeks before an initial due date. The students are provided with a qualitative rubric on the expectations and the assessment protocol. Upon the assignment submission, the students receive feedback on their initial submission and shall re-submit their revised assignment in a week. Student submissions are continuously processed during this submission window, and qualitative feedback is provided to help them better their current solutions.

The iterative process encourages students to improve their shortcomings and hone their competencies and skills. It helps alleviate any assessment-related anxieties since the students can improve their shortcomings and demonstrate an improved understanding of the concepts. In the summative assessments, students are given a remedial assignment for unsatisfactory results. A qualitative assessment rubric helps students much achieve a satisfactory rank on the assessment to pass it. A sample assessment and the associated passing criteria is included in Appendix 1. In the case of exams, students should achieve a satisfactory rank on most of the questions (often 70% or more). Similarly, for quizzes that are based on the 'university's learning management systems, students should get all questions, at least, most of the questions correct and have multiple attempts to pass. Often such quizzes are designed out of a database of questions, and in each attempt, a random pool of questions on a selected topic is presented to the students.

Overall, if one were to convert to numeric grade values, the students should achieve 70-75% grade to pass the course. The grading sample of 'McMaster's Software Engineering Technology program is presented in Appendix 2. It must be noted that the passing criteria for a course has been shifted to a significantly higher level using this Residency model. The students must strive more and undertake more exploratory learning to pass the course than an equivalent course offered in a graded format. As a result, on average, a student graduating out of these courses is expected to have a better skill set.

Course curricula like those mentioned establish the feasibility of executing gradeless frameworks within a graded institution. It further establishes the feasibility of executing gradeless frameworks within a graded institution. It indicates that gradeless courses can be just as academically rigorous, if not more, as their graded counterparts. It also demonstrates that different types of assessments and various marking schemes can be the complement of the course's content and learning objectives.

Moreover, numerous promising studies show the benefits of gradeless learning in higher education. for instance, Bloodgood et al. (2009) showed that students who participated in a pass/fail system in their first four semesters of university exhibited significant improvements in their psychological well-being with reduced levels of stress, anxiety, and competitive feelings. Students also felt greater satisfaction in their personal lives and in the quality of their education while displaying in the same academic performance (Bloodgood et al., 2009). Rohe et al. (2006) showed that students in a pass/fail system experienced lower stress, greater group cohesion compared to their graded peers (Rohe et al., 2006), reduced reduce peer pressure and rivalry (Jacobs et al., 2014). Finally, surveys from McMorran et al. (2017) demonstrated that an overwhelming number of students agreed with and understood the purpose of gradeless learning, such as helping students in their transition to higher education, encouraging the development of life-long learning, and making emboldened exploratory choices with coursework.

3. DISCUSSION AND CONCERNS

While adopting a gradeless curriculum offers positives impacts, removing grades as an incentive will lead to poorer learning attitudes. Surveys of students (McMorran et al., 2017) and faculty (McMorran & Ragupathi, 2020) at the National University of Singapore revealed that while both groups support the intentions of a gradeless system, they also had concerns about students paying less attention in class and skipping lectures once the pressure of getting a bad mark was removed. Michaelides and Kirshner (2005) claimed that such concerns might because students often spend less time and effort on modules with pass/fail outcomes than graded modules. However, increasing the rigour of the curriculum and raising the bar on the minimum requirement to earn a passing grade could mitigate such concerns.

Besides, the expectation or pressure upon teachers to adjust to this paradigm shift on short notice and with limited consultations (McMorran & Ragupathi, 2020). The shift to virtual learning during the pandemic is a notable example. Teachers were burdened with the responsibility of enlightening pupils while themselves learning entirely new frameworks for teaching and learning. Wary of this while we are still emerging out of the pandemic, at 'McMaster's W Booth School, the transition to the Residency model was carefully planned. We had over a yearlong consultations involving faculty members, committees at the university, student bodies, and members in external universities. Finally, omitting grades on assignments does not prevent learning from being facilitated through other methods.

In addition, Students who received descriptive feedback on formative assessments performed significantly better in subsequent tests for quantitative analysis and problem solving than those who did not (Butler & Nisan,

1986). A programming course in Northwestern University in Illinois becomes an explicit example. Christopher Riesbeck, an associate professor in electrical engineering and computer science, had used a critique-based assessment method for 20 years as his teaching strategy. In this method, he provided a detailed critique or feedback on the students' works. Building off the feedback, the students revised their work and sent it back to the professor. This cycle continued until the professor no longer has any critiques to make (Riesbeck, 2017). These cases showcase the importance of constructive and comprehensive feedback in facilitating active learning, especially in the absence of letter and numerical grades. It is also essential for the students to recognize that the merit of learning goes beyond the GPA.

In summary, achieving this shift in perspective may be the greatest challenge associated with a gradeless learning system (McMorran et al., 2017). Fortunately, as with most other facets of society, the pandemic has provided the necessary impetus for a paradigm shift around teaching and learning. Many instructors (Levine, 2021) and institutions (Rickers, 2021) are seeing this as an opportunity to experiment with gradeless assessments and have shown promising results.

4. CONCLUSION

Grade-based assessments are usually unavoidable to assess students' learning outcomes. Educational institutions are persisting grade-based assessment, despite its tendency to divert students from the true essence of education and discourage exploration, due to its easy implementation. Nevertheless, over the years, several educators have adopted and demonstrated the feasibility and positives of the gradeless education system. The Harvard Medical School has shown its successful implementation of adopting gradeless learning. Similarly, referred to as the Residency model, the W Booth 'School's Software Engineering Technology program at McMaster has also witnessed the successful implementation of gradeless learning. This has shown a significant promise in evolving engineering education processes to propagate exploratory learning, discovery, innovation, and ultimately transforming graduates into life-long self-learner. The new assessment and evaluation model in engineering education will be evident over time when the graduates launch themselves into the employment market.

APPENDIX -1

A sample assessment and the associated passing criteria. In determining the altitudes of a series of points, with respect to some reference point, the measurements are subject to error. Thus, more observations are taken than what is strictly needed to determine the altitudes, and the resulting system is solved. Suppose there are 4 points whose altitudes x_1, x_2, x_3, x_4 are to be determined. In addition to the direct measurements of each x_i , with respect to the reference point, measurements are also taken of each point with respect to each other. An example is shown below:

$$\begin{aligned}x_1 &= 2.95 \\x_2 &= 1.74 \\x_3 &= -1.45 \\x_4 &= 1.32 \\x_1 - x_2 &= 1.23 \\x_1 - x_3 &= 4.45 \\x_1 - x_4 &= 1.61 \\x_2 - x_3 &= 3.21 \\x_2 - x_4 &= 0.45 \\x_3 - x_4 &= -2.75\end{aligned}$$

We establish the corresponding least squares system $A\hat{x} \cong b$ and apply the Householder transformation function and the backward substitution functions developed in the assignments to solve for the best values of the altitudes. Determine how these values compare to the direct measurements (given in the first 4 equations) made for the 4 altitudes, i.e., Δx .

Note:

1. Your PDF submission should include the complete algorithm package, including the following functions: Householder, backward Substitution that work for a general $m \times n$ ($m > n$) system.

2. You cannot use a built-in householder or backward substitution functions for the program.
3. Your program should print the matrix A after applying all the householder transformations. It should also print the calculated values of the altitudes \hat{x} , and Δx .

Passing criteria for the assessment:

1. The data in point 3 should be included in your PDF submission before your code in the pdf file. Do not print screenshots with a black background.
2. Include the complete code for all the functions. Do not print images of the code or paste code with a black background.
3. Obtain the correct answers for \hat{x} , and Δx .

APPENDIX -2

A sample assessment schema is as follows:

Quizzes (10%):

Quizzes are just to check the basic knowledge on the topics. Each Quiz will be open for one week and students will have unlimited attempts to pass a quiz. A student must get 100% in a quiz to pass the quiz. All quizzes will be administered through avenue.

Assignments (10%):

Assignments will be based on the questions covered in the classroom and will require students to do some additional reading to help them understand and extend the concepts. These are at a higher level of assessment than the quizzes. A detailed rubric will be given for each project, explaining the passing criteria. Students will have a resubmission opportunity for the projects. Each project is graded as satisfactory (S=1) or unsatisfactory (U=0).

Challenge Projects (10%):

Each challenge project will test a cumulative knowledge on a set of topics taught in the previous weeks. The challenge projects will require students to have a good understanding of the topics and will assess their ability to apply the concepts to solve situational problems. Students are expected to do some exploratory reading to solve the project. A detailed rubric will be given for each project, explaining the passing criteria. Students will have a resubmission opportunity for the projects. Each project is graded as satisfactory (S=1) or unsatisfactory (U=0).

Midterm Exam (10%):

The Midterm Exam will have 4-6 questions and students will have to get an S grade on at least 80% of the questions in order to pass the midterm. Each question will provide students with a detailed rubric on expectations for achieving a S grade on that question. Students will be given a second attempt to pass the midterm exam. Each question in the midterm is graded as S(=1) or U(=0).

Midterm portfolio (20%):

Students will submit a reflection piece on the contents covered until the midterm. The claims in the reflection piece will be supported with the assessments that they have appeared for until the midterm exam. A detailed rubric will be provided for the midterm portfolio. The portfolio is graded as S(=1) or U(=0).

Final Exam (20%):

The Final Exam will have 4-6 questions and students will have to get a S grade on at least 50% of the questions in order to pass the final exam. There is only one attempt for the final exam. Each question in the final exam is graded as S(=1) or U(=0).

Final portfolio (20%):

Students will submit a reflection piece on the contents covered in the course. The portfolio is an extension of the midterm portfolio and will be a compilation of their work in the course. The claims in the reflection piece will be supported with the assessments that they have appeared for until the final exam. A detailed rubric will be provided for the final portfolio. The portfolio is graded as S(=1) or U(=0).

To pass the course a student must achieve the following:

Quizzes – Pass every quiz.
 Assignments – Pass every assignment
 Challenge projects – Pass every challenge project
 Midterm exam – Pass the midterm exam
 Midterm portfolio – Pass the midterm portfolio
 Final exam – Pass the final exam
 Final portfolio – Pass the final portfolio
 Final grade in the course will be pass (P) or fail (F).

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