

## PAPER

# The Assessment of a Gradeless Residency Model for Software Engineering Education

Adan Amer<sup>1,2</sup>, Gaganpreet Sidhu<sup>2</sup>, Seshasai Srinivasan<sup>2</sup>(✉)

<sup>1</sup>Dalla Lana School of Public Health, University of Toronto, Ontario, Canada

<sup>2</sup>W Booth School of Engineering Practice and Technology, McMaster University, Ontario, Canada

[ssriniv@mcmaster.ca](mailto:ssriniv@mcmaster.ca)

## ABSTRACT

The traditional practice of assessing academic performance through conventional letter and numerical grades has faced criticism for its limitations in promoting active engagement and curiosity among students. In response, the concept of gradeless education has gained traction, with the aim of fostering a more holistic learning experience. This work explores the implementation of the residency model, a form of gradeless education, in the context of engineering education. The model focuses on skill acquisition and competency demonstration while enhancing student wellness by minimizing assessment-related anxiety that students often face in graded assessments. This study evaluates the effectiveness of the residency model through a comprehensive survey conducted in a software engineering technology program at McMaster University. The survey investigates student perspectives on the model's impact on motivation, learning experience, and attitudes towards learning. The results reveal a complex interplay of attitudes, with students acknowledging the importance of grades while appreciating the model's rigorous assignments. The findings suggest that the residency model can encourage transformative learning experiences while warranting ongoing attention to optimize both learning outcomes and student well-being. Further research is recommended to assess the long-term impact and effectiveness of gradeless education models, emphasizing both their benefits and challenges.

## KEYWORDS

write gradeless learning, software engineering, engineering pedagogy

## 1 INTRODUCTION

Traditional assessment methods that utilize letter and numeric grades have been used almost ubiquitously across academic institutions to measure students' academic performance [1–3]. This practice has been used for over a century as a way to motivate and reward students for hard work and successful studying while also penalizing students who produce substandard work [4, 5]. Yet, for as long as grades have been ingrained in the educational system, scholars have criticized their

Amer, A., Sidhu, G., Srinivasan, S. (2024). The Assessment of a Gradeless Residency Model for Software Engineering Education. *International Journal of Engineering Pedagogy (IJEP)*, 14(6), pp. 139–154. <https://doi.org/10.3991/ijep.v14i6.47187>

Article submitted 2023-12-05. Revision uploaded 2024-04-21. Final acceptance 2024-05-13.

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utility in producing actively engaged and curious students who are ready to enter the workforce. These points of critique include observed racial inequities in how grades are distributed to students displaying similar academic performance [5–9], an increased level of stress, anxiety, and competition among students who fear receiving below-average grades [1, 6, 10], and stifled creativity and exploration as a tradeoff for meeting narrow assessment criteria [5, 11]. Another reason the graded system has garnered so much criticism is due to its potential role in shifting generations of learners into prioritizing extrinsic motivators for success, such as a high grade or praise from others, rather than intrinsic reasons for learning like discovery, self-actualization, and skill-building [3, 5, 7, 10, 12, 13]. Moreover, the low reliability and consistency of grading schemes across professors, classes, and institutions place the validity of traditional grading systems in question [13–19], especially in the face of pervasive grade inflation [20–22]. Nonetheless, letter and numerical grades are useful tools for judging and sorting students by a set criterion, which can subsequently be used by academic institutions to select applicants for lucrative funding opportunities or to indicate the effectiveness of an educator's teaching practice [4, 5, 17, 23].

A potential alternative to an educational system that heavily depends on letters and numerical grades to unreliably measure students' learning outcomes is a system without them [19]. An example of such a system is one where every assessment in the course is evaluated on a pass/fail or satisfactory/unsatisfactory basis by being qualitatively assessed for the demonstration of specific competencies. Upon successful demonstration of these competencies, the student could be assigned a 'pass' grade in the course, making them eligible to progress to the next level. Thus, the student receives credit for passing the course, whereas those who fail to demonstrate a certain level of the core competencies will receive no credit. In a binary assessment system like this, there is no differentiation between students who would otherwise receive a 75% or a 95% grade if both students are above the threshold for passing. Examples of institutions successfully implementing this system exist around the world. In the United States, the Massachusetts Institute of Technology uses a pass/no record system for all students in the first semester of their first year, whereas Stanford University's School of Medicine evaluates all medical students with a pass, fail, or incomplete score. 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. One could also incorporate a hybrid system that allows students to choose between having a letter grade or pass/fail on their transcript at the end of the semester based on what they believe is advantageous for them. This grade/pass-fail system was implemented at the National University of Singapore in the first semester of the first year for all students. In this implementation, choosing a grade affects their grade point average (GPA), while the other options do not. In addition to gradeless learning being implemented at an institution- or program-wide level, there are numerous examples of professors applying this framework to individual courses despite being embedded in a grade-dependent institution [3, 24, 25]. The grade-less system has varying purposes depending on the institution implementing it. Some of the notable objectives of employing gradeless assessments include easing the cognitive load on students as they transition into higher education, improving student well-being, and encouraging students to undertake exploratory learning in their courses [10, 26–27].

There is significant evidence in the literature to support the adoption of a gradeless format of education [6, 12, 13, 19, 26, 28–35]. In one study [26], researchers 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 feelings of competition. Students also felt greater satisfaction in their personal lives and in the quality of their education, while displaying no difference in academic performance. Similarly, [36, 37] showed that students in a pass/fail system experienced less stress and greater group cohesion compared to their graded peers, while displaying no differences in academic performance. Thematic analysis of the interviews from [37] further reinforces the notion that gradeless learning helps reduce the pressure and feelings of competition among peers. Finally, student surveys from [10] showed an overwhelming agreement with and understanding of the intentions behind gradeless learning, such as easing students' transitions into higher education, developing life-long learning behaviors, and making emboldened exploratory choices with coursework. Nonetheless, employing such a paradigm shift on students and faculty is bound to have its challenges, such as requiring extensive time and resources to change pre-established curricula and train educators, as well as increasing stress and anxiety in students as they learn to navigate a new system of assessment [1]. Additionally, removing numerical and letter grades for one component (class, program, or institution) does not negate the fact that these grades are used for many parts of the larger system that involves admissions to academic institutions, merit-based scholarships, and future job prospects [13, 15]. While there are plenty of positives to adopting a gradeless curriculum, there is concern that removing the incentive of grades might result in poorer learning attitudes, not better ones. Surveys of students and faculty show that both groups had concerns about students paying less attention in class and skipping lectures once the pressure of getting a bad mark was removed [1, 10, 13, 15]. Similarly, one study showed that students often spend less time and effort on modules that have pass/fail outcomes compared to graded ones [38]. However, this can potentially be mitigated by increasing the rigor of the curriculum and raising the bar on the minimum requirement to earn a passing grade. For instance, in the courses offered in Booth School's Software program, the students have to pass almost every assessment, demonstrating that they have attained the necessary skills and competencies before they can pass the course. Attendance has not been an issue with the students in the program because these students are mature and join the program with the very specific objective of advancing their careers.

Finally, a concern with institutions adopting gradeless learning is the expectation or pressure placed upon teachers to adjust to this paradigm shift on short notice and with limited consultations [1]. The shift to virtual learning prompted by the pandemic is a notable example of educators being burdened with the responsibility of enlightening pupils while themselves learning entirely new frameworks for teaching and learning. Fortunately, as with most other facets of society, the pandemic has provided the necessary impetus for a paradigm shift around teaching and learning.

Inspired by the benefits of a gradeless system of education, McMaster University's Software Engineering Technology Program has implemented its own version of upgrading titled the "Residency Model of Education" (hereafter referred to as the Residency Model) in Fall 2022. In this program-wide change, students spend 13 weeks acquiring core competencies related to a few subject-specific courses in computer sciences and software engineering. All courses in this program are evaluated as pass/fail, effectively eliminating the letter grade. With this significant change in assessments, an effort has been made to prioritize self-regulated and project-based learning at the core of the education process, offering students a transformative educational experience [39, 40]. The residency model was implemented after thorough

deliberation and consideration of various aspects, such as the quality of education and the increasing stress and health challenges faced by students. This pedagogical shift is anticipated to encourage exploratory learning, enhance student health and well-being, and lead to a more educated and enlightened citizenry who will play a crucial role in guiding and advancing society. The adopted pedagogical approach not only demonstrates the feasibility of implementing gradeless frameworks within a graded institution but also shows that gradeless courses can be equally academically rigorous as their graded counterparts.

The aim of this study is to evaluate the residency model as implemented at McMaster University by surveying students of the Software Engineering Technology Program to get their perspectives. Specifically, the objectives of this study were to: 1) understand the students' experience with gradeless courses as implemented in the residency model; 2) assess the efficacy of gradeless assessment, student-wellness improvements, and active learning strategies; and 3) determine strategies to improve the learning experience for students operating under the residency model. This study contributes to the existing body of knowledge around gradeless learning while also maintaining a distinct focus on the software engineering discipline and highlighting the unique perspective of mostly mature (25 years of age or older) students from diverse backgrounds. The study is important because the software engineering technology offered at McMaster is unique in Canada in that it offers an opportunity for full-time working professionals who have a three-year college diploma to advance their knowledge and obtain a four-year university degree through this two-year degree completion program. Literature discussing such pedagogical transformations for this demographic is nonexistent. The researchers hypothesize that students' responses will indicate a tendency to rely on external motivators such as traditional grades to progress their learning, as well as encounter challenges in navigating the courses under the residency model due to the enhanced rigor of the assignments. Additionally, the researchers hypothesized that students prefer having opportunities to iteratively improve their competencies through repeated submissions of assessments and that students will experience a decrease in feelings of stress and competition with peers.

## 2 METHODOLOGY

### 2.1 Overview of the residency model

At McMaster's W Booth School, the transition to the residency model was carefully planned by the software program faculty members. There were widespread consultations within and outside the university for over a year. After processing the proposed changes through various committees and sub-committees within the university, the transition was adopted in Fall 2022. The assessment methodology in the residency model was implemented as follows:

The general assessment methodology for a course is as follows: In every course, a set of assessments (e.g., technical reports, essays, coding assignments, e-portfolios) is distributed to students throughout the semester as outlined in the respective course syllabus. While the structure of assessments varies between the courses, they share a common marking scheme in the individual assessments completed by the students using a two- or three-level rating scheme. In a two-level rating scheme, the student earns either a 'satisfactory' (S) or 'unsatisfactory' (U) rating. In a three-level rating

scheme, an additional category of ‘exceeds expectations’ (E) is used. A typical course would have a collection of assignments, a set of short-challenge projects that may lead to a comprehensive project, and a midterm and final portfolio. To maintain timelines, ensure minimal turnaround times for feedback on the assessments, and conduct the course efficiently, the assignments are released two weeks before an initial due date; students are provided with a qualitative rubric on the expectations and the assessment protocol. The rubric focuses on evaluating the students’ ability to apply the target competencies to solve real-world engineering problems. Qualitative feedback is provided to the students to help them improve their understanding of the concepts. Upon submission of their solutions, the students receive feedback on their initial submission and are allowed up to a week to resubmit the revised assignment. Within this timeframe, students are allowed to make multiple submissions, and a dedicated teaching assistant assesses the submissions when they arrive. The iterative process is aimed at encouraging students to improve their shortcomings and be able to hone their understanding of the core competencies of the course. A similar approach is used for the projects that are assigned in the course. In summative assessments, students are allowed a second attempt if the first attempt is unsatisfactory (U-level). The evaluation rubric for all assessments is made clear and may require students to achieve at least an S-level for all project components and/or an S- and E-level on the majority (e.g., 70%) of the exam questions. Similarly, for quizzes that are based on the university’s learning management systems (LMS), students are usually required to get all questions correct and are given multiple attempts to achieve this objective. Often, such quizzes are designed out of a database of questions, and in each attempt, a random pool of questions is posed for a selected. Overall, if one were to convert the performance required to pass the course to numeric grade values, the students would theoretically be required to achieve a traditional grade equivalent of 70–75% to pass the course. Upon successfully mastering an array of competencies required in the course, students receive a ‘Pass’ grade, allowing them to earn the credits for the course.

## 2.2 Study recruitment for evaluating the residency model

To evaluate undergraduate students’ learning preferences and experiences in McMaster University’s Bachelor of Technology program, an online survey was conducted on the Lime Survey platform with students enrolled in the Bachelor of Technology programs between the Fall 2022 and Winter 2023 academic terms. Additionally, students registered in one or more courses in the Software Engineering Technology program were also included in the study. The online survey was distributed voluntarily and anonymously by course leaders or instructors. Only non-identifying information was collected, and students were neither incentivized to complete the survey nor penalized for non-participation. Basic information about the survey goals was communicated via email. The survey was disseminated electronically through email and on the university’s LMS (Avenue to Learn). It consisted of 28 questions categorized into three main themes: 1) grades as a motivating factor for student performance; 2) course experiences; and 3) attitudes towards gradeless learning influenced by the courses. For each theme, students were presented with statements and asked to indicate their level of agreement regarding the residency model and their course experiences. Additional questions inquired about students’ preferred types and their well-being in relation to the new marking scheme.

The complete set of survey questions and response types are detailed in Table 1. The survey was active for 4 weeks to encourage maximum participation and response, resulting in a total of 156 responses. The administration of this survey was approved by the McMaster University Research Ethics Board (MREB #6252).

**Table 1.** Table of survey questions and their corresponding response types

Question	Response Type
<b>Theme 1: Grades as a motivating factor</b>	
I actively collaborate with my peers to get a better understanding of the subject and the concepts	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
The academic rigour of the assignments is comparable to or better than those of my other grade-based courses	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
The rigour of the tests is comparable to or better than those of my other grade-based courses	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
Grades are the greatest motivating factor for my studies	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
I typically prefer to enroll in courses in which I'm confident about achieving a high mark even if the content isn't within my interests	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
I typically prioritize external motivating factors (like good grades, references, networking) over the intrinsic motivations for learning (discovery, knowledge acquisition, life-long learning)	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
<b>Theme 2: Course experiences</b>	
My stress levels have improved with regards to assignments as a result of this gradeless curriculum	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
I feel a lower sense of competition with my peers in this course compared to others	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
If presented with the option, I would choose a course with this framework over a similar course that uses numerical grades	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
The option to have the first iteration of my assignment revised and resubmitted has been beneficial to me	5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
With regards to the layout of this course, how is the lack of numerical grades affecting you?	5-point Likert scale (Extremely Negative, Negative, Neutral, Positive, Extremely Positive)
Is adequate time given to students to complete one iteration of the assignments?	Binary (Yes or No)
Is the turnaround time for revisions adequate?	Binary (Yes or No)
If given the choice, I would rather have: "Fewer chances to receive feedback on an assignment but more time to revise it"; or "More chances to receive feedback on an assignment with less time to revise it"	Multiple choice out of 2 options
If given the choice, I would rather have: "A small number of attempts on a quiz with a lower passing threshold"; or "An unlimited number of attempts but require a perfect score to pass"	Multiple choice out of 2 options
If given the choice, I would rather have: "Weekly quizzes"; "Monthly group assignments"; or "Two term tests"	Multiple choice out of 3 options
If given the choice, I would rather have: "A final exam with a minimum passing threshold of 80%"; or "an ePortfolio project"	Multiple choice out of 2 options

(Continued)

**Table 1.** Table of survey questions and their corresponding response types (*Continued*)

Question	Response Type
<b>Theme 3: Perspective towards the Residency model</b>	
My perception of gradeless learning has changed as a result of taking this course	5-point Likert scale (Strongly Disagree – Strongly Agree)
Which of the following best represents your experience during this course: Gradeless learning as implemented in this course is ___ than graded learning	Multiple Choice: one of “more preferable”; “no different”; or, “less preferable”
Which of the following best represents your experience with gradeless learning as implemented in this course: My social well-being has __ as a result of gradeless learning	3-point Likert Scale (Improved, Not changed, Worsened)
Which of the following best represents your understanding of course content as presented in this gradeless curriculum: My understanding of the course material has __ as a result of the gradeless curriculum	3-point Likert Scale (Improved, Not changed, Worsened)
Which of the following best represents your enjoyment of course content as presented in this gradeless curriculum: My enjoyment of the course material has __ as a result of the gradeless curriculum	3-point Likert Scale (Improved, Not changed, Worsened)

### 2.3 Data analysis

The data collected through the surveys were exported as comma-separated values and imported into R version 4.3.1 for descriptive analysis. Questions with a 5-point Likert scale response type were presented as proportions of respondents across all response levels, means, and standard deviations (SD), with 1 representing the lowest level of agreement or satisfaction (“strongly disagree” and “extremely negative”, respectively) and 5 representing the highest level (“strongly agree” and “extremely positive”). Neutral responses are represented by the number 3. Questions with a 3-point Likert scale were presented just as proportions of respondents across all levels (“Improve”, “Not changed”, and “Worsened”). Select responses for the rest of the questions were presented in bar graphs as proportions of total respondents.

## 3 RESULTS

Out of a total of 300 active students in the program, 156 (52%) responses were recorded. Full summaries of scaled survey responses are available in Tables 2 and 3. When surveying the students about the advantages and disadvantages of the model used in the Software Engineering and Technology Program, researchers identified common practices in the students’ approach to gradeless learning. These included student preferences for revisable assignments and e-Portfolio projects over standard tests. The researchers also pinpointed key barriers that students experienced in learning in the gradeless environment.

**Table 2.** Summary of results for questions with 5-point Likert scale response types

Statement	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean Out of 5	SD*
I actively collaborate with my peers to get a better understanding of the subject and the concepts	10.2	10.2	25.4	44.1	10.2	3.34	1.12
The academic rigour of the assignments is comparable to or better than those of my other grade-based courses	15.5	13.8	27.6	29.3	13.8	3.12	1.27
The rigour of the tests is comparable to or better than those of my other grade-based courses	12.1	15.5	32.8	29.3	10.3	3.10	1.17
Grades are the greatest motivating factor for my studies	13.8	19.0	13.8	25.8	27.6	3.34	1.42
I typically prefer to enroll in courses in which I'm confident about achieving a high mark even if the content isn't within my interests	22.4	32.8	15.5	15.5	13.8	2.66	1.36
I typically prioritize external motivating factors (like good grades, references, networking) over the intrinsic motivations for learning (discovery, knowledge acquisition, life-long learning)	12.1	22.4	20.7	25.9	19.0	3.17	1.31
My stress levels have improved with regards to assignments as a result of this gradeless curriculum	28.8	20.3	11.9	15.2	23.7	2.85	1.57
I feel a lower sense of competition with my peers in this course compared to others	8.6	25.9	24.1	25.9	15.5	3.14	1.22
My perception of gradeless learning has changed as a result of taking this course	17.2	22.4	22.4	20.7	17.2	2.98	1.36
If presented with the option, I would choose a course with this framework over a similar course that uses numerical grades	27.6	13.8	19.0	6.9	32.8	3.03	1.63
The option to have the first iteration of my assignment revised and resubmitted has been beneficial to me	10.3	5.2	10.3	34.5	39.7	3.88	1.29
With regards to the layout of this course, how is the lack of numerical grades affecting you?	23.6	27.3	9.1	25.4	14.6	2.80	1.43

Note: \*SD = Standard Deviation.

**Table 3.** Summary of results for questions with 3-point Likert scale responses

Statement	Improved	No Change	Worsened
My social well-being has ___ as a result of gradeless learning, as implemented in the course	25.5	45.5	29.1
My understanding of the course material has ___ as a result of this gradeless format	29.1	52.7	18.2
My enjoyment of the course material has ___ as a result of this gradeless format	27.3	45.5	27.3

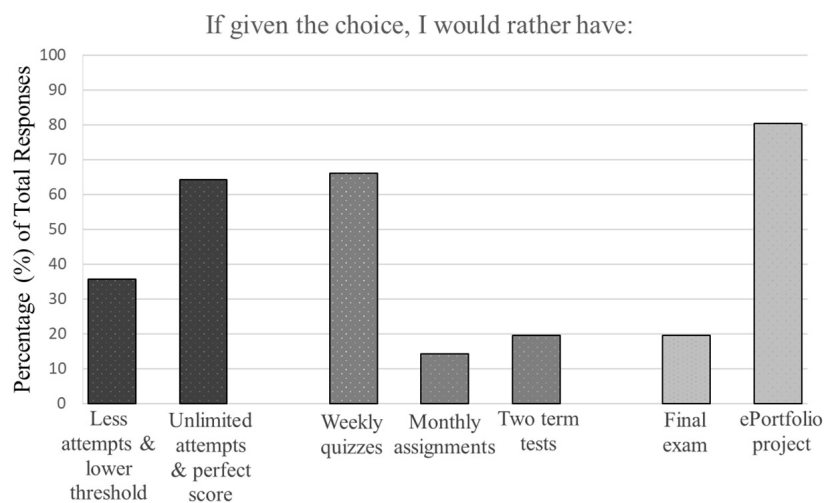
When students were asked questions about the influence of achieving high numerical grades on their motivation, about 53% either agreed or strongly agreed with the sentiment that grades were their greatest motivating factor for their studies (Table 2). Similarly, a greater proportion of students (45%) either agreed or strongly agreed with the sentiment that they tend to prioritize external motivating factors, such as good grades, over intrinsic ones, such as self-discovery. Both responses to these questions aligned with the hypothesis that undergraduate engineering students often place great value on achieving high marks, sometimes at the expense of their desires for life-long learning or discovery. Having said this, nearly 55% of the



students disagreed with the idea of having a preference or tendency to enroll in courses in which there is a greater guarantee of a high grade, even if the subject matter lies out of their interest. The second objective of the study was to understand the merits of the gradeless curricula implemented in the program from the students' point of view. Students were asked to reflect on the rigor of the course assessments under the residency model when compared to other grade-based courses in their schedule. Most students agreed or strongly agreed with the statement that the academic rigor of assignments (43%) and class tests (40%) were comparable to or greater than the other grade-based courses they had taken in the past.

With respect to the stress levels and the sense of competition that they felt in the new learning format, a slight majority of students felt a lower sense of competition with their peers (41%), and nearly 50% of the respondents felt that the stress levels were the same as in the graded format.

Students were also surveyed for their preferences regarding different assessment types. As summarized in Figure 1, approximately 64% of the students favored the option of having unlimited attempts on an assessment, even if the passing threshold is very high, as opposed to a finite number of attempts but with a relatively lower threshold. Furthermore, about 66% of students prefer weekly quizzes over monthly group assignments and midterm tests. Regarding the culminating assessment, 80% of students prefer the e-Portfolio project over a comprehensive final exam (see Figure 1). It is important to note that the final exam does not offer any resubmission opportunities for the students.



**Fig. 1.** A cluster of bar graphs showing the frequency distribution of responses to three assessment-related questions

The final objective of the study was to understand students' attitudes towards gradeless learning systems as implemented in the course through the residency model. As shown in Table 3, nearly 45% of the students were either neutral or approved of the residency model. The remaining students found the transition challenging and expressed a desire to see changes in the implementation of the residency model.

Another major piece of information from the survey was regarding student wellness. As seen in Table 3, around 29% of the students continued to face wellness issues and felt stressed while operating under the residency model.

## 4 DISCUSSION

The results of the present study show mixed attitudes from students towards gradeless learning as implemented in the Software Engineering and Technology program. Most students agree that they prioritize grades over intrinsic reasons for their pursuit of learning. This aligns with other studies that found extrinsic factors to be the primary motivators for students [10, 15, 16, 19]. This inclination is likely due to the fact that, throughout their schooling years, advancement to higher levels was based on letter and numerical grades. Furthermore, their admission to university was party-grade-based, and students have been conditioned to believe that good grades indicate a strong grasp of the subject, while poor grades signify a lack of understanding [12, 18, 31]. The majority of respondents also acknowledge that grades are their main motivator when progressing through a course (refer to Table 2). Despite this, students refute the idea of enrolling in easier courses at the expense of their personal interests (commonly referred to as “bird courses”). This is not surprising, as the students entering this program are mature individuals who are either employed full-time in the industry or have already completed a three-year college program. These students are highly motivated to learn and have a clear vision of the learning objectives they aim to achieve to advance their careers. In essence, their response reflects their dedication to learning and their eagerness to master concepts and principles that will benefit them in their professional lives.

Students' experiences in the course varied significantly. Most students believe that the assignments and tests in the courses showed a comparable level of academic rigor or even higher than those found in regular grade-based courses. The survey results clearly debunk the popular notion that gradeless assessments are ‘easy’ or ‘not challenging enough’ [13, 15, 29, 41]. This difficulty was intentional, as the course leaders and researchers determined during the planning stages of the study that the level and quality of the assessments would be elevated above the graded version. By doing so, students were encouraged to engage in self-study and exploratory learning beyond the course content to broaden their knowledge.

In terms of social well-being, students reported experiencing less pressure to compete with their peers in these courses (refer to Table 2), which aligns with the cited literature about the benefits of gradeless learning in reducing rivalries among students [1, 15, 27, 31, 35, 36]. Despite this, students still feel that their stress levels regarding assignments did not decrease (refer to Table 3). This is expected due to the heightened difficulty of the assignments, which are designed to foster exploratory learning and innovative thinking. This poses a challenge to the students because: (a) many of the students are working full-time and have work-related commitments; and (b) all the students in the program had previously completed three years of higher education where this educational framework was not used. This made the courses in the current program feel completely unconventional and required a significant change in mindset, both of which can induce stress in students. Another point of stress, according to the qualitative responses submitted by a portion of the students, pertains to the deadlines set for revising and resubmitting an assessment. This highlights an important area for improvement in the study. Although it was hypothesized that students would feel less stress and gain a better understanding of course concepts through iterative feedback processes, the fact that an assessment must be revised and resubmitted within a shorter timeline (typically 2–3 weeks) places enormous stress on them. A potential solution to address this challenge and alleviate students' stress is to allow for a larger submission window. Additionally, from an administrative perspective, students should be advised not to enroll in too many courses in an attempt to expedite their education.

On the assessment front, there was a strong inclination towards frequent, lower-stakes assessment types, such as a weekly quiz with a perfect score requirement, compared to a midterm test that allowed a much lower threshold to pass successfully (see Figure 1). This suggests that students are willing to strive for more challenging goals if they are provided with ample opportunities. Additionally, since the passing threshold for the overall course is significantly higher in the residency model and an unsatisfactory outcome in any assessment component could have consequences, students may have a lower preference for demanding assignments and tests that are less forgiving of errors. For the same reason, e-Portfolio has been well-received by a large portion of students. The e-Portfolio serves as a collection of the students' work throughout the semester and necessitates that students reflect on their learning and progress. The reflective aspect of the e-Portfolio aims to broaden their perspective by addressing topics such as how they intend to apply this knowledge in their workplace, the challenges they encountered in grasping the concepts and skills, and how they overcame these challenges. Consequentially, the challenge-based pedagogical framework embraced in the residency model enables students to present a robust portfolio as aspiring engineers and leverage the e-Portfolio for future job opportunities. This is in line with existing literature on the advantages of and preferences for constructivist learning approaches that empower students to reflect on their newly acquired skills while concurrently establishing connections between concepts learned across various courses [42–48].

Finally, a key objective of the residency model was to alleviate the stress associated with assessments. In a traditional graded education system, students typically have only one opportunity to attempt an assessment, and their grades are determined solely based on this single attempt. Unfortunately, this approach tends to prioritize performance over learning [12, 34, 49], leading students to focus more on achieving high grades than understanding the concepts. The latest survey indicates that slightly over 50% of students are satisfied with the current implementation of the residency model. The dissatisfaction among the remaining students could be attributed to the rigorous curriculum, the absence of traditional grades, or difficulties in adapting to the new teaching method, among other factors. Given the significant shift in the grading system under the new program, these ratings can be viewed with optimism. It is common to encounter initial challenges with any large-scale changes, and it is possible that some students who had positive or neutral views about the model did not participate in the survey for various reasons. Those who expressed strong positive or negative sentiments about the course were likely more motivated to take part in the study. Some negative feelings towards the model may stem from students' concerns that potential employers may undervalue their knowledge acquired through pass/fail courses. This fear could also be the reason why some students felt that their social well-being was negatively affected. Additionally, some students are apprehensive about how graduate programs will perceive the new transcript format when they apply. Although not explicitly captured in the survey, there have been several discussions with students on this particular issue.

Lastly, a vast majority of students reported that gradeless learning has had no impact on their social well-being (refer to Table 3). This contradicts the results from other studies that found improved well-being in students who switched to gradeless learning [2, 10, 33, 41, 50], yet it is unsurprising given that students experience a variety of stressors that exist outside the confines of a single course or program. Technical disciplines, such as engineering and computer science, are particularly rigorous and strenuous for students. Thus, conclusions made about gradeless education in general might fall short when looking at its implementation in a particular field.

## 5 CONCLUSION

The present study sheds some insight into the implementation of the residency model, a gradeless curriculum, in the software engineering technology program at the W Booth School of Engineering Practice and Technology at McMaster University. Specifically, the study focused on determining the students' experience with the new gradeless system adopted in Fall 2022. The key objectives included assessing 1) the role of grades as a motivating factor for student performance, 2) students' experience in the courses, and 3) changes in students' attitudes towards learning in a gradeless environment, which were successfully obtained through a detailed survey. Grades were observed to be a major motivating factor for students to maintain high performance in their courses, as well as a higher priority for engaging with their course content. In terms of course experiences, student responses reflect an overall preference for assessment types that allow for a greater number of errors and revisions, especially as the academic rigor of these assessments is on par with traditionally graded courses in the same discipline. Students' wellbeing mostly remained neutral or declined because of their experiences in the course, while their perspective of gradeless learning as implemented in the residency model largely remained unchanged. The results indicate that students found the curriculum quite rigorous, and several students found it challenging to adapt to the new format of education. This, in turn, resulted in an elevation of stress among some students, which ran counter to the expectation that having more opportunities to rectify and demonstrate learning would result in a deflation of anxiety and foster student wellbeing. However, the students liked the notion of emphasizing student-centered learning and demonstrating their skills through a well-curated e-Portfolio. In other words, there are indications of a change in students' attitudes towards learning. While the majority of the students either stayed neutral or approved the residency model, a large fraction of them wanted an enhancement in the implementation to alleviate stress levels. The remedies identified at this stage include the following:

1. Increase the duration during which a student can resubmit their assessments after receiving feedback. This will help alleviate the pressure caused by time constraints. This is crucial because a significant number of students work full-time and would greatly benefit from the extra time.
2. The passing criteria for the courses could be a bit more relaxed. In several courses, students are required to pass every assessment (quizzes, assignments, challenge projects, midterm and final exams, and an e-Portfolio). This can create immense pressure on students who might be at risk of failing a course due to failing just one or two assessments. To enhance the system, the number of assessments could be decreased, or the passing criteria for the course could be adjusted to pass a significant majority of the assessments.
3. Considering the e-Portfolio as the summative assessment instead of a comprehensive final exam alleviates some of the stress on students. The final exam, typically held after the course concludes, lacks the flexibility of multiple attempts and a relaxed timeline for completion. Moreover, the stringent passing criteria of the course further escalate stress levels among students.

Strengths of the study include the high response rate (52% of the study base) and the heterogeneity of participants. The study was conducted across multiple courses with students from diverse lived experiences, career backgrounds, and ages. Additionally, the inclusion of mature students, a group often underrepresented

in studies of first-year undergraduate students, provides a unique perspective. Limitations of the study include the absence of a control group for contemporaneous comparisons with students in the courses using the residency model. Instead, students served as their own controls when comparing their previous course experiences to those in the gradeless scheme. Moreover, the novelty of the residency model presented challenges in observing its long-term effects, as it was recently implemented before the study began. A follow-up survey is planned for the next academic year to gain a better understanding of the student landscape and evaluate the effectiveness of the changes resulting from this study.

In conclusion, the residency model has been successfully launched to promote an emphasis on learning. However, some improvements need to be made to the resubmission schedule, pass/fail threshold, and summative assessment choice to ensure that, in addition to emphasizing learning, the residency model also promotes student well-being.

## 6 ACKNOWLEDGMENTS

The authors are grateful to the reviewers for their time in evaluating the manuscript and providing constructive criticism to help improve it. This research was funded by the MacPherson Institute as part of the Leadership in Teaching and Learning Fellowship Program.

## 7 REFERENCES

- [1] C. McMorran and K. Ragupathi, "The promise and pitfalls of gradeless learning: responses to an alternative approach to grading," *Journal of Further and Higher Education*, vol. 44, no. 7, pp. 925–938, 2020. <https://doi.org/10.1080/0309877X.2019.1619073>
- [2] S. M. Brookhart *et al.*, "A century of grading research: Meaning and value in the most common educational measure," *Review of Educational Research*, vol. 86, no. 4, pp. 803–848, 2016. <https://doi.org/10.3102/0034654316672069>
- [3] K. H. Greenberg, B. K. Sohn, and L. Moret, "Life in an ungraded course," *College Teaching*, vol. 71, no. 4, pp. 290–298, 2023. <https://doi.org/10.1080/87567555.2022.2046998>
- [4] R. M. Gold, A. Reilly, R. Silberman, and R. Lehr, "Academic achievement declines under pass-fail grading," *The Journal of Experimental Education*, vol. 39, no. 3, pp. 17–21, 1971. <https://doi.org/10.1080/00220973.1971.11011260>
- [5] H. T. Crogman *et al.*, "Ungrading: The case for abandoning institutionalized assessment protocols and improving pedagogical strategies," *Education Sciences*, vol. 13, no. 11, p. 1091, 2023. <https://doi.org/10.3390/educsci13111091>
- [6] L. Anderson, "A critique of grading: Policies, practices, and technical matters", *Education Policy Analysis Archives*, vol. 26, p. 49, 2018. <https://doi.org/10.14507/epaa.26.3814>
- [7] A. Kohn, "The case against grades," *Educational Leadership*, vol. 69, no. 3, pp. 28–33, 2011.
- [8] J. Feldman, *Grading for Equity*. CA, USA: Corwin Press, 2023. <https://us.corwin.com/books/grading-for-equity-2nd-edition-281503>
- [9] S. Gershenson, S. B. Holt, and N. W. Papageorge, "Who believes in me? The effect of student–teacher demographic match on teacher expectations," *Economics of Education Review*, vol. 52, pp. 209–224, 2016. <https://doi.org/10.1016/j.econedurev.2016.03.002>
- [10] C. McMorran, K. Ragupathi, and S. Luo, "Assessment and learning without grades? Motivations and concerns with implementing gradeless learning in higher education," *Assessment & Evaluation in Higher Education*, vol. 42, no. 3, pp. 361–377, 2017. <https://doi.org/10.1080/02602938.2015.1114584>

- [11] J. Schinske and K. Tanner, "Teaching more by grading less (or Differently)," *CBE Life Sci. Educ.*, vol. 13, no. 2, pp. 159–166, 2014. <https://doi.org/10.1187/cbe.cbe-14-03-0054>
- [12] R. Lynch and J. Hennessy, "Learning to earn? The role of performance grades in higher education," *Studies in Higher Education*, vol. 42, no. 9, pp. 1750–1763, 2017. <https://doi.org/10.1080/03075079.2015.1124850>
- [13] K. Lim, "Assessing beyond grades: Unravelling the implications on student learning and engagement in higher education," *Assessment & Evaluation in Higher Education*, pp. 1–15, 2024. <https://doi.org/10.1080/02602938.2024.2314703>
- [14] C. Hochbein and M. Pollio, "Making grades more meaningful," *The Phi Delta Kappan*, vol. 98, no. 3, pp. 49–54, 2016. <https://doi.org/10.1177/0031721716677262>
- [15] A. Kjærgaard, E. N. Mikkelsen, and J. Buhl-Wiggers, "The gradeless paradox: Emancipatory promises but ambivalent effects of gradeless learning in business and management education," *Management Learning*, vol. 54, no. 4, pp. 556–575, 2023. <https://doi.org/10.1177/13505076221101146>
- [16] L. Malam and C. Grundy-Warr, "Liberating learning: Thinking beyond 'the grade' in field-based approaches to teaching," *New Zealand Geographer*, vol. 67, no. 3, pp. 213–221, 2011. <https://doi.org/10.1111/j.1745-7939.2011.01213.x>
- [17] M. W. Durm, "An A is not an A is not an A: A History of Grading," *The Educational Forum*, vol. 57, no. 3, pp. 294–297, 1993. <https://doi.org/10.1080/00131729309335429>
- [18] A. Kohn, "The case against grades," *Counterpoints*, vol. 451, pp. 143–153, 2013.
- [19] A. Kohn and S. D. Blum, *Ungrading: Why Rating Students Undermines Learning (and What to Do Instead)*. Morgantown: West Virginia University Press, 2020. [https://muse.jhu.edu/pub/20/edited\\_volume/book/78367](https://muse.jhu.edu/pub/20/edited_volume/book/78367)
- [20] B. Park and J. Cho, "How does grade inflation affect student evaluation of teaching?" *Assessment & Evaluation in Higher Education*, vol. 48, no. 5, pp. 723–735, 2023. <https://doi.org/10.1080/02602938.2022.2126429>
- [21] K. B. Cox, "Putting classroom grading on the table: A reform in progress," *American Secondary Education*, vol. 40, no. 1, pp. 67–87, 2011.
- [22] T. J. Griffin, J. Hilton III, K. Plummer, and D. Barret, "Correlation between grade point averages and student evaluation of teaching scores: Taking a closer look," *Assessment & Evaluation in Higher Education*, vol. 39, no. 3, pp. 339–348, 2014. <https://doi.org/10.1080/02602938.2013.831809>
- [23] J. Schneider and E. Hutt, "Making the grade: A history of the A–F marking scheme," *Journal of Curriculum Studies*, vol. 46, no. 2, pp. 201–224, 2014. <https://doi.org/10.1080/00220272.2013.790480>
- [24] C. Riesbeck, "20 Years Gradeless: Having my cake and eating it too," *Teachers Going Gradeless*, 2022. <https://www.teachersgoinggradeless.com/blog/2017/07/10/20-years-gradeless>
- [25] W. J. Rapaport, "A triage theory of grading: The good, the bad, and the middling," *Teaching Philosophy*, vol. 34, no. 4, pp. 347–372, 2011. <https://doi.org/10.5840/teachphil201134447>
- [26] R. A. Bloodgood, J. G. Short, J. M. Jackson, and J. R. Martindale, "A change to pass/fail grading in the first two years at one medical school results in improved psychological well-being," *Academic Medicine*, vol. 84, no. 5, pp. 655–662, 2009. <https://doi.org/10.1097/ACM.0b013e31819f6d78>
- [27] L. S. Robins, J. C. Fantone, M. S. Oh, G. L. Alexander, M. Schlafer, and W. K. Davis, "The effect of pass/fail grading and weekly quizzes on first-year students' performances and satisfaction," *Acad. Med.*, vol. 70, no. 4, pp. 327–329, 1995. <https://doi.org/10.1097/00001888-199504000-00019>

- [28] R. Cropanzano and M. S. Mitchell, "Social exchange theory: An interdisciplinary review," *Journal of Management*, vol. 31, no. 6, pp. 874–900, 2005. <https://doi.org/10.1177/0149206305279602>
- [29] A. Joshi, P. Haidet, D. Wolpaw, B. M. Thompson, and R. Levine, "The case for transitioning to pass/fail grading on psychiatry clerkships," *Acad. Psychiatry*, vol. 42, no. 3, pp. 396–398, 2018. <https://doi.org/10.1007/s40596-017-0844-8>
- [30] A. Amer, G. Sidhu, and S. Srinivasan, "A consideration of gradeless learning in higher education," *International Journal of Pedagogy and Teacher Education*, vol. 7, no. 1, 2023. <https://doi.org/10.20961/ijpte.v0i0.73153>
- [31] S. Tannock, "No Grades in Higher Education Now! Revisiting the place of graded assessment in the reimagination of the public university," *Studies in Higher Education*, vol. 42, no. 8, pp. 1345–1357, 2017. <https://doi.org/10.1080/03075079.2015.1092131>
- [32] R. H. Stupnisky, R. P. Perry, R. D. Renaud, and S. Hladkyj, "Looking beyond grades: Comparing self-esteem and perceived academic control as predictors of first-year college students' well-being," *Learning and Individual Differences*, vol. 23, pp. 151–157, 2013. <https://doi.org/10.1016/j.lindif.2012.07.008>
- [33] R. Matthews and A. Noyes, "To grade or not to grade: Balancing formative and summative assessment in post-16 teacher trainee observations," *Journal of Further and Higher Education*, vol. 40, no. 2, pp. 247–261, 2016. <https://doi.org/10.1080/0309877X.2014.953456>
- [34] A. Kjærgaard, J. Buhl-Wiggers, and E. N. Mikkelsen, "Does gradeless learning affect students' academic performance? A study of effects over time," *Studies in Higher Education*, vol. 49, no. 2, pp. 336–350, 2024. <https://doi.org/10.1080/03075079.2023.2233007>
- [35] L. Spring, D. Robillard, L. Gehlbach, and T. A. Moore Simas, "Impact of pass/fail grading on medical students' well-being and academic outcomes," *Medical Education*, vol. 45, no. 9, pp. 867–877, 2011. <https://doi.org/10.1111/j.1365-2923.2011.03989.x>
- [36] D. E. Rohe, P. A. Barrier, M. M. Clark, D. A. Cook, K. S. Vickers, and P. A. Decker, "The benefits of pass-fail grading on stress, mood, and group cohesion in medical students," *Mayo Clinic Proceedings*, vol. 81, no. 11, pp. 1443–1448, 2006. <https://doi.org/10.4065/81.11.1443>
- [37] J. L. Jacobs, D. D. Samarasekera, L. Shen, K. Rajendran, and S. C. Hooi, "Encouraging an environment to nurture lifelong learning: An Asian experience," *Medical Teacher*, vol. 36, no. 2, pp. 164–168, 2014. <https://doi.org/10.3109/0142159X.2013.852168>
- [38] M. Michaelides and B. Kirshner, "Graduate student attitudes toward grading systems," *College Quarterly*, vol. 8, no. 4, pp. 1–15, 2005.
- [39] L. Vargas-Mendoza and K. Gallardo, "Influence of self-regulated learning on the academic performance of engineering students in a blended-learning environment," *International Journal of Engineering Pedagogy (ijEP)*, vol. 13, no. 8, pp. 84–99, 2023. <https://doi.org/10.3991/ijep.v13i8.38481>
- [40] J. A. Hurtado, A. C. Useche, and B. S. Masiero, "Project-based learning: Authentic engineering assessment supported by model design," *International Journal of Engineering Pedagogy (ijEP)*, vol. 13, no. 6, pp. 17–32, 2023. <https://doi.org/10.3991/ijep.v13i6.38539>
- [41] K. E. Lyboldt, K. D. Bach, A. W. Newman, S. N. Robbins, and A. J. Jordan, "Impact of satisfactory/unsatisfactory grading on student motivation to learn, academic performance, and well-being," *Journal of Veterinary Medical Education*, vol. 50, no. 5, pp. 554–563, 2023. <https://doi.org/10.3138/jvme-2022-0020>
- [42] P. Abrami, E. Bures, E. Idan, E. Meyer, V. Venkatesh, and A. Wade, "Electronic portfolio encouraging active and reflective learning," vol. 28, pp. 503–515, 2013. [https://doi.org/10.1007/978-1-4419-5546-3\\_32](https://doi.org/10.1007/978-1-4419-5546-3_32)
- [43] İ. Büyükduman and S. Sirin, "Learning portfolio (LP) to enhance constructivism and student autonomy," *Procedia – Social and Behavioral Sciences*, vol. 3, pp. 55–61, 2010. <https://doi.org/10.1016/j.sbspro.2010.07.012>

- [44] A. S. Hanbidge, C. McMillan, and K. W. Scholz, “Engaging with ePortfolios: Teaching social work competencies through a program-wide curriculum,” *The Canadian Journal for the Scholarship of Teaching and Learning*, vol. 9, no. 3, 2018. <https://doi.org/10.5206/cjsotl-rcacea.2018.3.3>
- [45] R. A. Mueller and H. Bair, “Deconstructing the notion of ePortfolio as a ‘High Impact Practice’: A self-study and comparative analysis,” *The Canadian Journal for the Scholarship of Teaching and Learning*, vol. 9, no. 3, 2018. <https://doi.org/10.5206/cjsotl-rcacea.2018.3.6>
- [46] A. Amer, G. Sidhu, Z. Bo, and S. Srinivasan, “A short review of online learning assessment strategies,” *International Journal of Pedagogy and Teacher Education*, vol. 6, no. 2, pp. 89–103, 2022. <https://doi.org/10.20961/ijpte.v6i2.66579>
- [47] M. J. Yee-King, M. Grierson, and M. d’Inverno, “Evidencing the value of inquiry based, constructionist learning for student coders,” *International Journal of Engineering Pedagogy (iJEP)*, vol. 7, no. 3, pp. 109–129, 2017. <https://doi.org/10.3991/ijep.v7i3.7385>
- [48] T. Köpeczi-Bócz, “Learning portfolio and proactive learning in higher education pedagogy,” *International Journal of Engineering Pedagogy (iJEP)*, vol. 10, no. 5, pp. 34–48, 2020. <https://doi.org/10.3991/ijep.v10i5.13793>
- [49] M. Brilleslyper, M. Ghrist, T. Holcomb, B. Schaubroeck, B. Warner, and S. Williams, “What’s the point? The benefits of grading without points,” *PRIMUS*, vol. 22, no. 5, pp. 411–427, 2012. <https://doi.org/10.1080/10511970.2011.571346>
- [50] R. Al-Sayyed, F. Abu Awwad, M. Itriq, D. Suleiman, S. AlSaqqa, and A. AlSayyed, “The pass/fail grading system at Jordanian universities for online learning courses from students’ perspectives,” *Frontiers in Education*, vol. 8, 2023. <https://doi.org/10.3389/educ.2023.1186535>

## 8 AUTHORS

**Ms. Adan Amer** is currently an MPH in Epidemiology at the Dalla Lana School of Public Health at the University of Toronto. She is also an interdisciplinary researcher with publications covering a range topic, including engineering pedagogy, Equity, Diversity & Inclusion (EDI) strategies in academia, crisis communication in industries, and environmental sustainability.

**Dr. Gaganpreet Sidhu** is a sessional lecturer at the W. Booth School of Engineering Practice and Technology at McMaster University. Dr. Sidhu holds a PhD in Materials Science from Toronto Metropolitan University. Her research interest focus on pedagogy, including curriculum design, student wellness, learning methodologies, and technology integration in education.

**Dr. Seshasai Srinivasan** is an associate professor at the W Booth School of Engineering Practice and Technology at McMaster University. He serves as the Chair of the Software Engineering Technology program and holds the Walter G. Booth Endowed Chair in Engineering Entrepreneurship and Innovation. His research interests focus on pedagogy, including cognitive psychology in teaching and learning, learning methodologies, technology integration in education, and curriculum development (E-mail: [ssriniv@mcmaster.ca](mailto:ssriniv@mcmaster.ca)).