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Understanding the Impact of Ungraded Assignments on Student Learning in Introductory Computing

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Abstract

This experience report explores the effects of ungraded assignments on the learning experience of students in introductory computing courses. Our study examines the impact of ungraded assignments on student engagement, understanding, and overall academic performance. We developed and administered new ungraded assignments for a required course in the first year of the Computer Engineering curriculum, ECE 120 Introduction to Computing. To assess their effectiveness, we employed a mixed-methods approach, including surveys, interviews, and performance analysis. Our analysis reveals a positive correlation between participation in ungraded assignments and overall course performance. However, this relationship may reflect pre-existing student motivation rather than the direct learning effects of the assignments themselves. Qualitative results indicate that competitive and socially driven designs, such as leaderboard-based optimization challenges, play an important role in motivating participation.

Keywords

Computer Engineering, Computer Science, Introductory Computing, Computing Education, Ungraded Assignments

1 Introduction

1.1 Motivation

Assessment has long been a cornerstone of education, with grades serving as a primary measure of student performance and progress. The traditional grading system, which assigns numerical or letter-based evaluations to student work, is widely used to standardize academic achievement and provide feedback to students and educators. In engineering courses, grading typically emphasizes correctness, efficiency, and problem-solving skills, assessed through exams, homework, laboratory work, recitations, and project-based evaluations. In Computer Science (CS) and Computer Engineering (CompE) courses, most assignments involve coding in a programming or hardware description language and are often graded using automated scripts. Such grading provides largely summative feedback, focusing on correctness rather than conceptual understanding or the learning process.

Although grading provides structure and accountability, research suggests that it can also introduce unintended consequences. Studies indicate that a high emphasis on grades can lead to performance anxiety[1], decreased intrinsic motivation[2,3], and a focus on short-term memorization, often described in the literature as bulimic learning, where students cram information for exams and quickly forget it afterward[4]. Particularly in rigorous technical fields like CS and CompE, where problem-solving and conceptual mastery are critical, students may prioritize earning high scores over developing a comprehensive grasp of the material.

In response to these challenges, some educators have begun exploring alternative assessment strategies that prioritize learning over grades. One such approach is the implementation of ungraded assignments that allow students to engage with course content without the pressure of formal evaluation. These assignments, which may take the form of design assignments, optimization challenges, proof-writing, reflection, and video watching, or competitive activities such as leaderboard-based challenges, aim to foster a deeper understanding by encouraging reflection, experimentation, and critical thinking.

Initial research on ungraded assignments suggests that they can enhance student engagement and promote a more collaborative and self-directed learning environment[5]. However, their effectiveness in technical disciplines such as CS and CompE remains an open question. This study seeks to explore how ungraded assignments influence learning outcomes, student motivation, and overall academic performance within these fields. We note that, unlike pedagogical 'ungrading,' our study focuses on optional tasks that are not included in the final course grade.

1.2 Literature Review

The literature review includes several key studies that highlight the potential benefits of ungraded assignments. "Will students engage if there are no grades? A review of the evidence, and an experiment in ungrading" by Williams[6] indicates a positive impact on student engagement and performance when grades are replaced with formative feedback. "Ungrading learner participation in a student-centered learning experience" by Koehler et al.[7] highlights the benefits of ungrading, such as promoting meaningful reflections and fostering a sense of respect and shared decision-making. More recently, "Ungraded classrooms: a pattern for learning in engineering modeled after expert practitioners" by Lingwall et al.[8] examines the impact of ungraded classrooms in geotechnical engineering, showing significant improvements in student attitudes and final exam scores. These studies collectively underscore the potential benefits of ungraded assignments in enhancing student learning experiences.

From a theoretical perspective, these findings align closely with self-determination theory[9], which posits that intrinsic motivation is supported when learners experience autonomy, competence, and relatedness. Ungraded assignments primarily support autonomy by reducing external control and allowing students to choose how and whether to engage with learning activities. When paired with formative feedback, they can also support competence by emphasizing growth and mastery rather than performance comparison. Additionally, ungraded and collaborative learning environments may foster relatedness by shifting interactions away from evaluative judgment toward shared exploration and mutual support.

1.3 Contributions

The key contributions of this paper are as follows.

1. We study the impact of ungraded assignments on learning outcomes in computer science and computer engineering education.
2. We create new assignments, categorize them according to the Bloom's taxonomy [10], and assess their estimated completion times and difficulty levels. Furthermore, we create a schedule of how to administer them during a typical 16-week semester, and discuss what kind of feedback will be provided to the students. We provide all these resources to the research and teaching community through a public GitHub repository.
3. We assess the effectiveness of these ungraded assignments using qualitative (feedback surveys and interviews) and quantitative (analyzing student grades) methods.

1.4 Organization

The remainder of this paper is organized as follows. Section 2 introduces relevant background. Section 3 describes the design and administration of the ungraded assignments. Section 4 presents quantitative and qualitative findings. Section 5 interprets these results, Section 6 outlines limitations, and Section 7 concludes the paper.

2 Preliminaries

This section provides background on Bloom's Taxonomy, which we use to categorize the cognitive skills targeted by the ungraded assignments.

2.1 Bloom's Taxonomy

Bloom's Taxonomy [10] is a hierarchical framework that categorizes cognitive learning objectives into six levels: Remember, Understand, Apply, Analyze, Evaluate, and Create. This taxonomy has been widely adopted in education to design curricula, assessments, and instructional methods that promote deeper learning and cognitive development.

In traditional grading systems, assessments often emphasize lower-order cognitive skills such as Remembering (e.g., recalling facts) and Understanding (e.g., explaining concepts). However, engineering education, particularly in CS and CompE courses, requires students to engage with higher-order cognitive processes such as Applying (e.g., writing code to solve problems), Analyzing (e.g., debugging or optimizing code), Evaluating (e.g., assessing the efficiency of algorithms), and Creating (e.g., developing software or hardware solutions).

Ungraded assignments offer opportunities to engage students across all levels of Bloom's Taxonomy. For example, design and proof-based assignments encourage higher-order thinking by requiring students to evaluate existing concepts, apply theoretical knowledge, and analyze different solutions. Optimization challenges and competitions promote creativity, as students must devise and implement novel solutions. Video-based learning activities support foundational learning by reinforcing understanding and remembering key concepts.

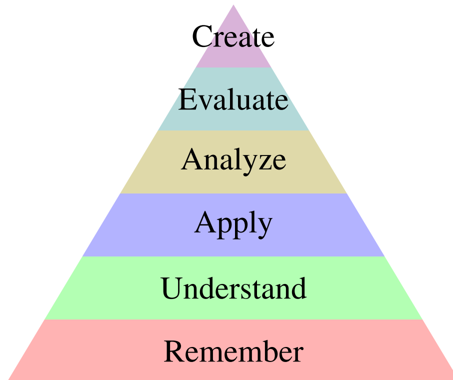

Figure 1: Bloom's Taxonomy[10] Pyramid illustrating the hierarchical cognitive processes involved in learning, from remembering basic knowledge to higher-order critical thinking and creativity.

3 Methodology

In this section, we describe the methodology used to design, implement, and evaluate the ungraded assignments. We outline the structure of the assignments, the rationale behind their sequencing, and the procedures used to administer them during the semester.

Week	Assignment
1	Two's Complement Proof
2	Logical Completeness Proof + Floating Point Video
3	
4	Transistor Design
5	Reflection 1
6	MUX Design
7	Latch Proof
8	
9	Reflection 2 + Vending Machine Video
10	Bonus Hardware Lab
11	Simple LC3 Program Optimization
12	Complex LC3 Program Optimization + LC3 Logic Optimization
13	Reflection 3 + Pokémon Video
14	Optimization Competition
15	Error Correction Video

Table 1: Sequencing of Assignments.

3.1 Developing the Ungraded Assignments

Ungraded assignments in this study encompass various types, each targeting different cognitive skills:

Assignments	Estimated Time to Complete	Bloom's Taxonomy	Difficulty Score
Two's Complement Proof	10 - 30 mins	Evaluate + Analyze	3
Logical Completeness Proof	10 - 30 mins	Evaluate + Analyze	3
Latch Proof	30 - 60 mins	Evaluate	3
Transistor Design	20 - 40 mins	Evaluate + Apply	2
MUX Design	10 - 20 mins	Analyze + Apply	2
Floating Point Video	18 mins	Understand	1
Vending Machine Video	1 min	Remember	1
Bonus Hardware Lab	3 - 5 hours	Create	3
Pokémon Video	58 mins	Remember	1
Error Correction Video	19 mins	Understand	1
Simple LC3 Program Optimization	1 - 3 hours	Create	5
Complex LC3 Program Optimization	2 days	Create	10
LC3 Logic Optimization	3 - 6 hours	Create	7
Optimization Competition	-	Create	-

Table 2: Details of Assignments.

1. Proof-Based Assignments – These tasks deepen theoretical understanding by examining topics such as two's complement and latches through formal proofs.
2. Design Assignments – Students apply classroom knowledge to solve practical problems, exploring the tradeoffs of different design choices.
3. Optimization Challenges – Given a specification, students write an LC3[11] program in machine language or assembly, aiming to minimize the number of instructions.
4. Optimization Competitions – Building on the optimization challenges, this assignment introduces an anonymized leaderboard that displays top-performing submissions.
5. Reflections – Students critically assess their learning progress, reinforcing key concepts and identifying areas for improvement.
6. Video-Based Learning – Engaging and informative videos introduce topics like floating-point arithmetic and Hamming codes, providing additional context and real-world relevance.

Table 1 shows the specific sequencing of the ungraded assignments. We strategically aligned the timing of these assignments with the lecture and discussion material, ensuring they reinforce topics as they are covered in class. For example, the two's complement proof assignment is scheduled for the same week that the lecture covers two's complement representation. During exam weeks—specifically, weeks 5, 9, and 13—the assignments are intentionally lighter to prevent additional strain and allow students to focus on their exams. We've also included a reflection assignment, timed post-exam, when students have had a chance to consolidate their understanding and can offer more meaningful insights.

Regarding assignment types, we aimed to create categories that complement rather than duplicate the content of homework and labs. The first category, proofs, was chosen because proofs are often

Assignments	Feedback Given
Two's Complement Proof	Formative
Logical Completeness Proof	Formative
Latch Proof	Formative & Summative
Transistor Design	Formative & Summative
MUX Design	Formative & Summative
Floating Point Video	Summative
Vending Machine Video	None
Bonus Hardware Lab	Summative
Pokémon Video	None
Error Correction Video	Summative
Simple LC3 Program Optimization	Summative
Complex LC3 Program Optimization	Summative
LC3 Logic Optimization	Summative
Optimization Competition	Summative

Table 3: Feedback for Assignments.

underemphasized in ECE, so these assignments give students an opportunity to engage deeply with topics they may not have fully explored before. Since ECE 120 is an introductory course, students rarely get to design from scratch, so design assignments prompt them to consider foundational design choices and trade-offs. To balance the ungraded nature of these assignments, we included lighter, more engaging tasks—such as informative videos that are also enjoyable. In contrast, we also incorporated a few challenging optimization problems, including one that is extremely challenging, to illustrate the complexity that engineering problems can entail while offering rewards for those who go above and beyond to tackle them. One of these tasks was extended into a leaderboard-based competition, which allowed students to compare their solutions anonymously and iteratively improve their submissions, providing an additional motivational element beyond the standard optimization assignments.

Table 2 summarizes each assignment type, including estimated completion time, Bloom's Taxonomy level, and difficulty score. These estimates are based on past student experiences, course material complexity, and assignment timing, which can significantly influence perceived difficulty. For example, although the simple LC3 optimization challenge is conceptually straightforward, it receives a difficulty score of 5 because it is introduced early in the course, when students are still becoming familiar with LC3 programming.

The type of feedback provided for each assignment is listed in table 3.

3.2 Administering the Ungraded Assignments

The ungraded assignments were administered during Spring 2025 (January 21–May 7) and Fall 2025 (August 25–December 10), with modifications discussed in Section 3.4. Assignments were released on Gradescope according to Table 1. Submissions were graded with detailed feedback from course staff, and late submissions were accepted to support formative learning.

Importantly, these assignments were hosted on a separate Gradescope page, distinct from the main course page used for ECE 120 homework and exams. This separation was intentional, aimed at keeping the optional ungraded assignments differentiated from the core course components. Students were invited to join this dedicated Gradescope page via a class-wide announcement posted on our Campuswire forum.

For most assignments that required a submission, students were expected to upload their written work to Gradescope. However, there were a few notable exceptions. The bonus hardware lab assignment asked students to design and build a digital circuit on a breadboard and demonstrate it in person during office hours. Students who completed this task were recognized on a special 'Hall of Fame' page titled 'The Exclusive Order of ECE 120'.

The optimization challenges were also administered differently. While they were technically released on Gradescope like the other assignments, they were also prominently announced on the class Discord server. Students were informed that completing the simple LC3 program optimization challenge would be particularly helpful for Lab 10, which was due the week following the challenge's release.

To further incentivize engagement, students who completed either the complex LC3 program optimization or LC3 logic optimization challenges were awarded a cosmetic Discord tag titled 'Optimization King' or 'Optimization Queen', visible to others on the server. The complex LC3 program optimization challenge was explicitly marketed as extremely difficult. Students who completed it had their names announced during the final exam review session, an event led by the head of course staff and attended by many students.

Each participant in the optimization competition was assigned an anonymized name in the form of a random Pokémon (or could choose their own), and submissions were tracked on a leaderboard visible to all participants. To recognize top performers, the top three students were awarded a cosmetic Discord tag titled 'Optimization Legend'.

3.3 Understanding the Effect of Ungraded Assignments

3.3.1 Feedback Surveys

To gain insight into students' perceptions of the assignments and their impact on learning outcomes, we developed a completely anonymous feedback survey that was distributed during the breaks following the Spring 2025 and Fall 2025 semesters. The survey included two categories of questions:

1. Likert-type questions:
    - (a) How difficult did you find the ungraded assignments overall? (1 = Very Easy, 5 = Very Difficult)
    - (b) On average, how much time did you spend on each ungraded assignment? (1 = $<$10 minutes, 5 = $>$2 hours)
    - (c) How helpful were the ungraded assignments in improving your understanding of the material or helping you prepare for assignments and exams? (1 = Not Helpful, 5 =

Extremely helpful)

   (d) How likely would you be to complete the ungraded assignments if extra credit were offered? (1 = Not Likely, 5 = Extremely Likely)

2. Short-answer questions:
   (a) What suggestions do you have for improving the ungraded assignments?
   (b) Aside from extra credit, what could motivate you to complete the ungraded assignments?
   (c) If you started doing the ungraded assignments but stopped, what was the main reason? If you didn't attempt them at all, why not?
   (d) Did you ever look at the ungraded assignments and work on them without submitting? If so, why did you choose not to submit them?
   (e) If you chose to participate in the optimization competition, what motivated you? Did you choose to do it over other ungraded assignments, and if so, why?

The short-answer questions focused on gathering students' suggestions to improve the ungraded assignments. This emphasis was intentional, as the survey was conducted after the semester ended and low participation had already been observed, as noted in the Results section.

3.3.2 Interviews

We designed a set of interviews with the primary goal of understanding one key issue (shown in the Results section): the discrepancy between the high participation rate in the optimization challenges and the comparatively lower participation in the other ungraded assignments. To explore this, we focused the interviews around two main questions:

1. Why did you feel more motivated to solve the optimization challenges over the rest of the assignments?
2. Do you think the direct communication with the head of course staff on Discord played a role in your decision to participate in the optimization challenges, compared to the other assignments submitted through Gradescope?

3.3.3 Student Grades

To evaluate the impact of the ungraded assignments, we compare the exam performance of students who chose to complete them with that of those who did not. Specifically, we analyze midterm and final exam scores between these two groups to assess any meaningful differences in learning outcomes.

3.4 Spring 2025 vs. Fall 2025 Implementations

There were several notable differences in the implementation of the ungraded assignments between the Spring 2025 and Fall 2025 semesters:

1. **Introduction of an optimization competition.** The optimization competition was developed and administered in Fall 2025, but was not part of the Spring 2025 implementation. This change was informed by student feedback expressing interest in more competitive elements, such as visible scores and leaderboards (Section 4.3.2), as well as by the comparatively high engagement observed for the optimization challenges in Spring 2025 (Figure 2). In response, we designed a leaderboard-based LC-3 optimization competition. Consequently, survey question (e), which focused on the optimization competition, was included only in the Fall 2025 feedback survey.
2. **Increased emphasis on visibility and promotion.** Student feedback from Spring 2025 highlighted challenges related to awareness and discoverability of the ungraded assignments (Sections 4.3.1 and 4.3.3). In response, Fall 2025 implementation placed greater emphasis on visibility, including more frequent and deliberately attention-grabbing Gradescope announcements intended to ensure students noticed and remembered the availability of ungraded assignments.
3. **Changes to data collection methods.** Due to difficulties in recruiting students for follow-up interviews, as reflected in the low participation rates shown in Table 4, interviews were not conducted in Fall 2025. Instead, an additional survey question (question (e)) focusing on students' experiences with the optimization competition was added to the feedback survey to capture qualitative insights.
4. **Removal of the bonus hardware lab.** The bonus hardware lab assignment was not offered in Fall 2025 due to technical issues with students' laboratory kits.

4 Results

This section presents the findings from our study, beginning with a summary of student participation in the ungraded assignments and research activities. This is followed by two parts: **Quantitative Results**, which include analysis of student grades and Likert-scale survey responses, and **Qualitative Results**, which summarize insights from open-ended survey responses and follow-up interviews.

4.1 Participation Overview

Metric	Spring 2025		Fall 2025	
	Count	%	Count	%
Students enrolled in the course	336	100.0	409	100.0
Enrolled in the ungraded assignments page	49	14.6	121	29.6
Participated in any ungraded assignment	20	6.0	32	7.8
Completed survey	14	4.2	16	3.9
Interviews conducted	2	0.6	–	–

Table 4: Participation in ungraded assignments and research activities across Spring 2025 and Fall 2025. Percentages are reported relative to total course enrollment for each semester.

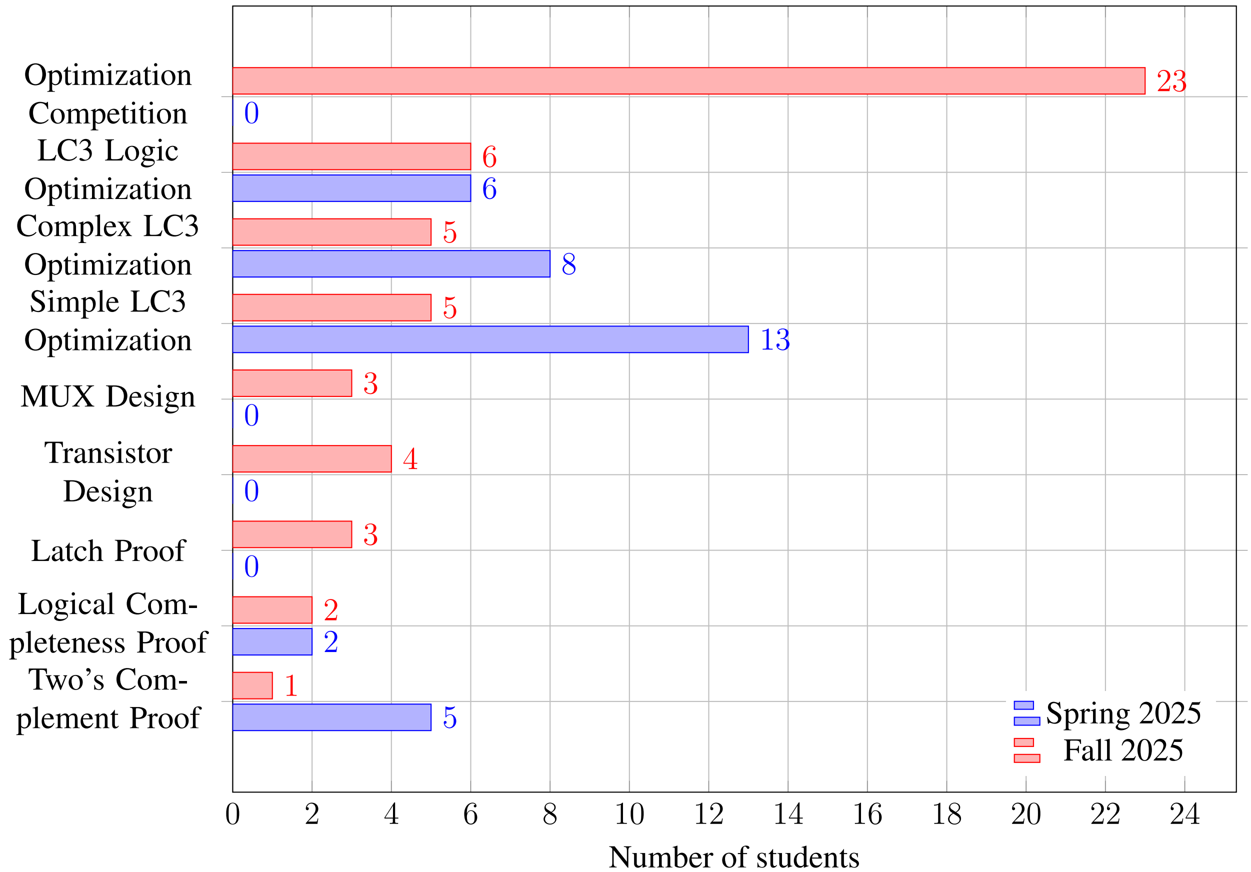

Figure 2: Student participation counts for each ungraded assignment across Spring 2025 and Fall 2025. Assignments with no participation are not shown.

Table 4 summarizes student participation in the ungraded assignments and related research activities across both semesters. In Spring 2025, of the 336 enrolled students, 49 (14.6%) joined the ungraded assignments Gradescope page, representing the largest drop-off in participation. Only 20 students (6.0% of the class, or 40.8% of those enrolled) completed at least one assignment. In Fall 2025, participation increased at each stage: of 409 enrolled students, 121 (29.6%) joined the page, more than doubling the Spring 2025 enrollment rate, and 32 students (7.8% of the class, or 26.4% of those enrolled) completed at least one assignment.

Figure 2 presents the number of students who participated in each ungraded assignment across Spring 2025 and Fall 2025. In Spring 2025, participation was highest for the LC3 optimization challenges, with 13 students completing the simple LC3 optimization, 8 completing the complex LC3 optimization, and 6 completing the LC3 logic optimization. In Fall 2025, while participation in these optimization challenges remained comparable, the introduction of the optimization competition resulted in substantially higher engagement, with 23 students participating.

Among students who participated in at least one ungraded assignment, the feedback survey was distributed to nearly all identifiable participants. In Spring 2025, the survey was sent to 19 of the 20 participants (one student could not be identified), and 14 students responded, yielding a response rate of 73.4%. Additionally, two students participated in follow-up interviews. In Fall

2025, the survey was distributed to all 32 participants, of whom 16 completed the survey, corresponding to a response rate of 50.0%. No interviews were conducted during the Fall 2025 semester.

4.2 Quantitative Results

Exam	Semester	Participants (Mean ± SD)	Non-participants (Mean ± SD)	p-value
Midterm 1	Spring 2025	93.8 ± 5.6	83.2 ± 13.0	9.46×10^{-8}
	Fall 2025	90.0 ± 9.9	82.1 ± 13.3	2.46×10^{-4}
Midterm 2	Spring 2025	88.6 ± 9.6	73.8 ± 17.8	3.28×10^{-6}
	Fall 2025	86.0 ± 12.2	78.0 ± 15.5	1.66×10^{-3}
Midterm 3	Spring 2025	95.2 ± 4.7	80.7 ± 16.4	2.83×10^{-13}
	Fall 2025	87.0 ± 9.2	78.4 ± 17.1	4.40×10^{-5}
Final	Spring 2025	91.4 ± 7.3	78.8 ± 17.2	5.50×10^{-7}
	Fall 2025	92.0 ± 8.0	85.1 ± 16.2	2.33×10^{-4}

Table 5: Comparison of exam performance between students who participated in ungraded assignments and those who did not, using Welch's t-test. Results are shown separately for Spring 2025 and Fall 2025.

Table 5 summarizes the mean exam scores (±SD) for participants and non-participants, along with p-values from Welch's t-tests, shown separately for Spring 2025 and Fall 2025. Across both semesters and all four exams, participants consistently scored higher than non-participants. In Spring 2025, differences ranged from 10.6 to 14.5 percentage points, while in Fall 2025, differences ranged from 7.8 to 12.6 percentage points. All differences were statistically significant (p-value < 0.005), indicating that students who engaged with the ungraded assignments outperformed their peers in both semesters.

Figure 3 presents grouped boxplots (medians drawn in red) comparing Spring 2025 and Fall 2025 student ratings for perceived difficulty, time required, usefulness, and the importance of the extra credit incentive. Across both semesters, difficulty ratings were consistently high, while the extra credit incentive was rated at or near the maximum by nearly all respondents, with reduced variability in Fall 2025. In contrast, ratings for time required and usefulness exhibited greater dispersion across both semesters, though Fall 2025 shows slightly more concentrated distributions. This variability is consistent with the heterogeneous design of the ungraded assignments. For instance, the simple LC3 optimization challenge was intended to be short, straightforward, and directly applicable, whereas the complex LC3 optimization challenge was deliberately longer, more demanding, and less directly useful.

4.3 Qualitative Results

We analyzed student responses to four open-ended survey questions and follow-up interviews. The findings are organized by question, with themes synthesized into non-identifiable summaries of student perspectives.

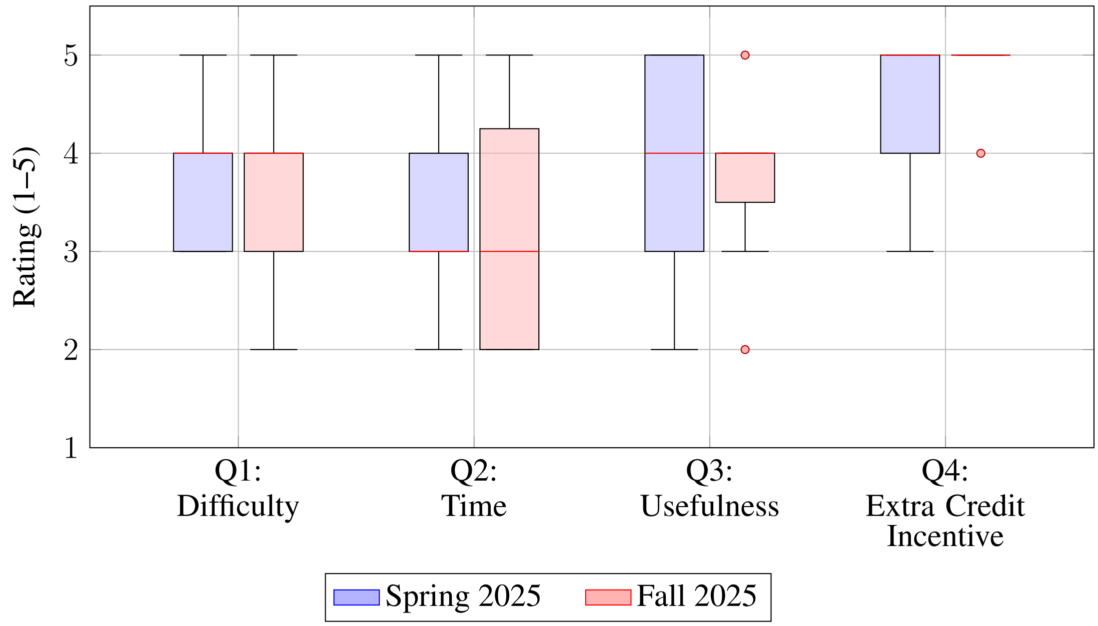

Figure 3: Comparison of Likert-scale survey responses across Spring 2025 and Fall 2025.

4.3.1 Suggestions for Improving Ungraded Assignments

Across Spring and Fall 2025, students suggested ways to increase the usefulness and visibility of the ungraded assignments. Some noted that participation tended to be self-selecting, appealing to students already interested or intrinsically motivated. Others emphasized that the assignments were not always easy to locate and suggested that clearer or more frequent communication would improve engagement. Although multiple announcements were made in Fall 2025, many students still reported low awareness of when or where the assignments were posted.

Students in Fall 2025 also expressed interest in more competition-style elements, such as challenges or leaderboards. Across both semesters, respondents requested a broader range of difficulty levels and tasks that aligned more directly with core technical content. Those who engaged with the ungraded work generally viewed it positively, describing it as enjoyable, helpful for learning, and useful for exploring concepts beyond standard coursework.

4.3.2 Motivation Beyond Extra Credit

When asked what might motivate participation aside from extra credit, students frequently cited intrinsic interest, the appeal of challenges, and the value of feedback. Many found the course content sufficiently engaging to work on optional tasks without external incentives.

Competitive elements were a recurring theme, with students suggesting that features such as visible scoring, anonymous rankings, or opportunities for peer comparison could increase participation. Social motivators—such as encouragement or recognition from peers—were also mentioned. Nevertheless, some students expressed skepticism that anything other than extra credit would significantly broaden participation, citing time constraints or competing priorities.

4.3.3 Reasons for Stopping

Students who initially participated but later stopped often cited time limitations, heavy workloads, or declining interest. Some reported that after a period of disinterest or competing academic demands, they simply forgot the assignments existed. Others described stepping away during exam-heavy weeks or when the optional tasks felt less relevant to ongoing coursework.

Accessibility also affected participation. Several students noted they might have continued if the assignments were integrated into commonly used course platforms, making them easier to locate during busy periods. Overall, sustained engagement depended on interest, available time, perceived relevance, and ease of access.

4.3.4 Reviewing Without Submission

A small number of students reported skimming or partially completing the ungraded assignments without submitting them, feeling that formal submission was not worth the additional effort. In some cases, students who meaningfully engaged with the content deprioritized submission because the assignments carried no grading incentives.

4.3.5 Motivations for Participating in the Optimization Competition

Students identified multiple overlapping motivators for participating in the optimization competition. Many were drawn to the competitive environment, particularly the leaderboard and the ability to compare performance with peers in an anonymized way. Social factors—such as seeing friends participate or receiving encouragement—also played a strong role.

Students frequently described the challenge itself as intrinsically rewarding. Several noted that the competition helped them improve their debugging skills, optimize code, or tackle a unique technical puzzle that extended beyond routine coursework. For some, the activity created a sense of accomplishment or excitement not found in other ungraded assignments.

Overall, the combination of challenge, social reinforcement, and structured competitive elements made the optimization competition more engaging than the other optional tasks.

4.3.6 Interviews

Interviews with two Spring 2025 students provided additional insight into engagement with optional coursework. Both were aware of the ungraded assignments but did not consistently complete them. Their participation depended largely on how the tasks were framed: activities presented as “challenges” or connected to graded components elicited more interest. Direct interaction with course staff had little influence on participation. These interviews reinforce the broader theme that presentation, perceived relevance, and integration with graded work significantly affect engagement.

5 Discussion

First, there is a clear and persistent issue with awareness. As shown in Table 4, only 14.6% of students in Spring 2025 and 29.6% in Fall 2025 ever accessed the ungraded assignments page.

Many students reported forgetting about the assignments due to a lack of reminders and limited visibility, a concern that was even more pronounced in Fall 2025. Survey responses highlighted the importance of better promotion, with students suggesting multiple announcements or more prominent placement on class platforms to increase engagement.

Regarding the assignments themselves, the optimization challenges and especially the competition were consistently the most popular, as shown in Figure 2. In Fall 2025, the introduction of the optimization competition reinforced the role of competitiveness and peer influence in motivating students. Even lighthearted or playful elements—such as Pokémon names for the leaderboard and special Discord tags—can make participation enjoyable enough to engage students who might not otherwise attempt the assignments.

Interestingly, as shown in Table 2, the optimization challenges and competition were the only activities categorized under the Create level of Bloom's taxonomy, while the rest of the ungraded assignments targeted lower levels. This indicates that tasks emphasizing open-ended creation and problem-solving may have been particularly engaging compared to assignments focused on recall, understanding, or application.

Beyond presentation and competitiveness, students generally preferred to focus on work that contributed to their grades. This aligns with survey responses indicating that extra credit remains an important incentive, as illustrated in Figure 3. However, Fall 2025 data suggest that intrinsic motivators such as enjoyment, challenge, and peer engagement can also encourage participation, particularly when assignments are framed in a fun and socially interactive manner.

There is also a strong correlation between participation in ungraded assignments and overall course performance, as shown in Table 5. Students who engaged with the assignments scored significantly higher than non-participants across all four exams. However, this pattern is consistent even for Spring 2025 midterms that cover material unrelated to the weeks when assignments had any participation (weeks 1, 2, 10, 11, and 12). This suggests that the observed performance differences are less likely due to the learning effect of the assignments themselves and more likely reflect pre-existing student motivation and engagement. Survey responses further support this interpretation, indicating that ungraded assignments primarily attract students who are already motivated to excel in the course.

6 Limitations

This study had several limitations that may have influenced participation and findings. First, awareness of the ungraded assignments was limited. Beyond a single announcement at the beginning of the semester inviting students to join the Gradescope page, no additional class-wide reminders were provided in Spring 2025, even though assignments were posted according to the schedule in Table 1. In Spring 2025, the authors had direct control over only one lecture section and the course Discord server, meaning that no reminders were delivered during other lecture sections, discussion sections, or office hours. In Fall 2025, while the authors continued to control the Gradescope page and the Discord server, they had no influence over lecture sections. Additional Campuswire announcements were made in Fall 2025 to increase awareness, but overall visibility remained limited. Hosting the ungraded assignments on a separate Gradescope page—requiring students to manually enroll—also likely decreased participation.

Second, participation in the ungraded assignments was entirely voluntary, meaning that students self-selected into the “participant” group. As a result, the comparison between participants and non-participants is subject to self-selection bias, limiting group equivalence and threatening internal validity. Students who were classified as “participants” had completed at least one ungraded assignment; this binary categorization does not distinguish between minimal and sustained engagement with the ungraded assignments and may obscure differences in degree of exposure. We adopted this threshold to preserve statistical power given the relatively low participation rates. As was concluded, students who chose to engage were likely more motivated, academically stronger, or more interested in the material prior to the ungraded assignments. Consequently, the observed differences in performance cannot be interpreted as causal effects of the ungraded assignments, but rather as correlations potentially reflecting pre-existing differences in motivation and engagement.

Additionally, the survey was distributed only to students who had completed at least one ungraded assignment, as we wished to avoid a post-semester class-wide announcement. This approach excluded students who never engaged with the assignments, potentially limiting the diversity of perspectives represented. Moreover, there was no incentive for completing the survey or participating in interviews, and invitations were sent during students’ summer break. These factors likely contributed to the low response rate for both data collection methods.

7 Conclusion and Future Directions

This study highlights that while overall participation in ungraded assignments was low, the students who did engage were largely self-motivated and reported meaningful benefits. Our findings suggest that thoughtfully designed ungraded assignments, particularly those emphasizing creativity and competition, can deepen learning and foster engagement beyond traditional coursework.

If this experiment were to be repeated, a key improvement would be to increase awareness of the ungraded assignments. This could be achieved by mentioning them regularly in all lecture sections, discussion sections, and office hours, as well as making frequent announcements about the current week’s assignment. Posting the assignments directly on the main course page—alongside graded work—would also help integrate them into students’ regular workflow and reduce the risk of them being forgotten.

For surveys and interviews, offering small incentives such as gift cards, raffle entries, or snacks could encourage greater participation. This would be particularly important if data collection occurs outside of the regular semester, when student engagement tends to drop.

8 Ethical Considerations

Our study was reviewed by the Institutional Review Board (IRB) and was determined not to constitute Human Subjects Research.

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