A Flexible Late Day Policy Reduces Stress and Improves Learning

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ABSTRACT

We present a non-grade-penalty late day policy used in many of the large lecture, required courses in our computer science department. We study the effectiveness of this late day policy in reducing student stress, distributing demand for teaching assistant resources in peak hours before the homework deadline, and in maintaining or improving student understanding and homework grades. A complex late day policy can be efficiently implemented and managed within our open-source homework submission system that utilizes automated testing and grading, allowing students to submit and resubmit homeworks as they make progress on the assignment.

1. SIGNIFICANCE AND RELEVANCE OF THE TOPIC

In large enrollment courses it is important to have well-defined and firm deadlines for homework assignments. This ensures students stay on track learning the material, promotes good time management skills, and facilitates efficient, consistent, and fast turnaround grading of the work by TAs.

One common technique for allowing leniency in homework deadlines allows students to submit late work, but applies a small percentage penalty on the score. This policy gives students some flexibility, but the small penalty seems harsh and students may be reluctant to submit late work. Instead, they might submit incomplete work or nothing at all.

When designing a late day policy for a computer science course we need to consider some things that other disciplines don't. Computer science assignments in particular are prone to unforeseen issues and in many cases it's difficult to finish an assignment on time even though it was started early. Some semantic errors can take a long time to debug. Internet outages or computer malfunctions can make it impossible to work on assignments.

Our homework submission system allows us to easily manage late days on a per student basis. As such, we employ an alternate strategy for most of the introductory and many of the intermediate and upper-division programming courses in our department. Each student is given a fixed number of "late days" (typically 3) at the start of the term. Students may use these late days as they need them to submit a homework assignment after the deadline for no score penalty. We intend the "late days" to cover minor illnesses, an unusually busy week in other courses, an unlucky computer hardware malfunction, etc. Unlike the score penalty late day policy, with our penalty-free late day policy we believe students are more likely to complete the assigned work and the learning process for the targeted material. *We believe this policy is both compassionate and empowering to our students.* We note that for any homework deadline and late submission policy it is appropriate to grant additional exceptions for significant student illness or rare personal or family emergencies.

SIGCSE '17 March 08-11, 2017, Seattle, WA, USA

ACM ISBN 978-1-4503-4698-6/17/03…$15.00

DOI: http://dx.doi.org/10.1145/3017680.3022439

2. CONTENT

We have been using a home-grown, open-source, homework submission system, with automated testing, partial automated grading, and online supplemental TA grading for many years.

Malmi et al.[4] observed that on demand feedback combined with a resubmission policy improved student performance and freed teaching resources. Other researchers have confirmed that feedback [1] and resubmission [5, 4, 3, 2] improves student performance.

A key feature of our homework system is multiple homework submissions. Our homework submission website is generally available 4 days before each weekly deadline and students are encouraged to submit work early to confirm that they are on the right track. Each submission is tested, autograded, and archived, wherein we then allow the student to select only one of these submissions for TA grading and their final grade.

Thanks to the automated and robust late day implementation, we have recently begun to explore more complex variants to our late day policy.

One late day policy extension is in response to the surge in enrollment of our introductory courses. In our Data Structures course, we now use short multiple choice electronic clicker exercises during lecture. Rather than tie a direct percentage of the course grade to participation or accuracy of response, we reward regular participation in clicker exercises with additional late days.

A second late day policy extension is in response to stu-

dents' tendency to procrastinate and failure to start the homework sufficiently early, which leads to a high demand for TA assistance just hours before the main homework deadline. For select homeworks we offer an incentive that if students submit a draft of their solution early and the automated testing and grading system validates that they have made substantial progress on the homework at least 24 hours before the main homework deadline, they are granted a one day extension on this deadline. With this incentive, students are encouraged to start early and ask for help from the TAs early. Many of the students earn an extension, which reduces the demand and stress for TA help hours before the original deadline, allowing both TAs and students to interact more productively.

We studied both the archive of homework submissions from prior terms as well as surveyed students from current and prior terms. For both portions of the study we received approval from our university Institutional Review Board for use of human subjects in the survey and our methods to ensure the confidentiality of the participants and their data.

We created a detailed survey with general questions on electronic homework submission, homework resubmission, automated grading, late day policies, and questions specific to certain courses.

We collected the email addresses students who have used our homework submission server for one or more courses and emailed invitations to just over 2,300 students who still had valid university email accounts. We received 707 valid responses to the survey.

We anonymized the survey results and the archive of old submissions and auto-grading results using the same mapping from username to anonymized string. Furthermore, we replaced the usernames from directory names and filenames within the archive with the anonymized string. Finally, we scrubbed the contents of the files to remove all first names, last names, usernames, and student ID numbers that students may have used in their code.

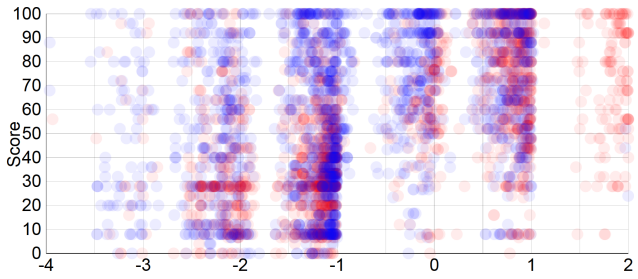
We have data from a variety of undergraduate level courses: Computer Science 1 (CS1), Data Structures (DS), Software Engineering (SE), Operating Systems (OS), Programming Languages (PL), Databases (DB), and Visualization (VIS).

We created a database of the anonymized survey responses and submission history. For every submission uploaded to our system we collect the submission timestamp, the submission number, and any auto-grading scores. For each course we store data for each homework including the due date and time, and the maximum possible auto-grading score.

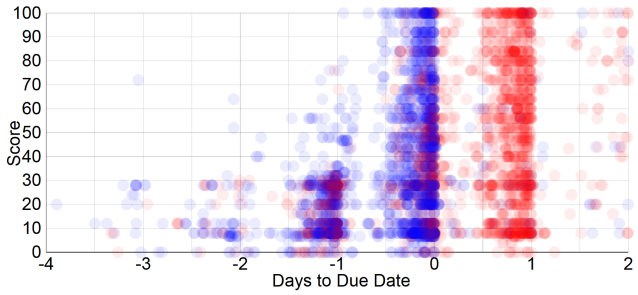
Through the survey responses and anonymized archival data we have been able to collect a large amount of qualitative and quantitative data. With this data we have been able to determine students' attitudes towards our late day policies as well as how they use them.

Our non-grade-penalty late day policy has had some interesting side effects. By examining the timestamps on students submissions we are able to see the trends in late day usages as semesters progress. What is arguably more interesting are the trends in late day usage as academic careers progress.

In figure 1 we plot students' late day usage when the extra late day incentive is offered. In the top graph we plot the students' submission history for assignments when the extra late day was earned. Students who did not use any late days on that assignment are plotted in blue while those who used at least one late day are plotted in red. We can observe that the two graphs are almost inverses of each other. Students who started before the incentive deadline nearly always achieved the incentive and grades cluster above the 50% mark while students who did not achieve the incentive rarely started before the deadline and the grades are not condensed to any particular score range.



(a) Students who earned the 1 day extension



(b) Students who did not earn the 1 day extension

Figure 1: Submission history for Data Structures homeworks with a special incentive for early submission demonstrating reasonable progress. Submissions for assignments with a final submission one or more days late are colored red. All other submissions are blue.