

WIP: Automated Flexible Extensions for Improving Learning Equity in Large Scale Computing Classrooms

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Abstract—This Work-In-Progress Innovative Practice paper describes a new flexible, at-scale assignment extension policy and its implementation in large undergraduate computing classrooms. While prior work has studied flexible deadlines and their effect on student learning, such policies are still under-utilized in post-secondary classrooms due to practical constraints on administrative workload, from managing hundreds to thousands of requests to reducing excessive grading overhead, especially in large post-secondary classrooms. The *Flextensions* tool—an automated flexible extension assignment software—promotes equitable learning opportunities in higher education by providing sufficient accommodations to each student’s unique learning needs and life circumstances. Part of *Flextensions* is a scalable software tool implementation that facilitates instructor management of extension requests across thousands of students and a variety of course policies.

We present *Flextensions* and describe initial experiences with adapting the tool to computer science and data science undergraduate courses at an R1 institution in the United States. This work shares the open-source software that enables and streamlines the management of extension requests across different course policies. Additionally, we provide an initial analysis of flexible extensions in three specific large-scale (500–1500 students) undergraduate computing courses. Overall, students tended not to take advantage of the policy but rather used it only when needed, with many citing extenuating circumstances—personal or otherwise. By analyzing survey results, the policy was well-received, with positive impressions on well-being, learning outcomes, and overall academic experience. One student-reported benefit was that many felt valued as individuals in the classroom. Despite some students still reporting stigma towards requesting an extension, *Flextensions* has the promising ability to improve the quality and responsiveness of creating accommodations in large-scale classrooms.

Index Terms—Higher education; Equity; Educational Software

I. INTRODUCTION

In principle, a student’s course grade should reflect their learning and understanding of course content. As an incentive, many higher education computing courses consist of assessing student learning over time through low-stakes, weekly or biweekly assignments. In reality, such assignments are

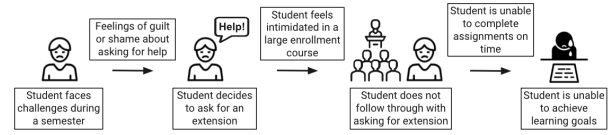


Fig. 1. Barriers to assignment extensions in large-enrollment courses.

bound with late work penalties and reward quality work only if it is submitted according to rigid deadlines [1]. While time management is undoubtedly a critical skill, students can face *extenuating circumstances* throughout the semester—unexpected challenges that inhibit and demotivate their course learning, such as personal or family emergencies, sickness, or academic burnout.

Such issues are exacerbated “at scale,” as seen in Figure 1. With the recent acceleration of computing and data-driven technology, enrollments in introductory Computer Science (CS) and Data Science (DS) classes at certain four-year institutions have skyrocketed [2]. Prior work has identified numerous challenges of teaching and learning at scale, including isolation, decrease in motivation, and student retention [3]. These barriers can compound existing student mental health issues in STEM higher education, often attributed to unmanageable workloads, notoriously difficult assignments, or unforgiving classroom policies [4]. Ultimately, if student grades are defined largely by missing or late assignments, such rigid classroom structures will not foster equitable student learning.

An alternative course design promotes competency-based learning by providing students ample opportunity to achieve grade proficiency given sufficient *time* [5]. One such strategy is *flexible deadlines*, which proactively identifies student extenuating circumstances as a significant barrier to student learning on assignments. By offering the opportunity for communication and deadline flexibility, the strategy removes excessive time pressure and instead encourages assignment completion.

While studies from the past two decades show the potential

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benefits of flexible deadlines [6], they focus on small-scale classrooms. In large-scale classrooms, students can feel isolated and anonymous, with a resulting decrease in motivation and student retention, while the educator’s challenge lies in engaging and interacting with students as individuals [3]. Anecdotally, receiving ample support in these classes has often been difficult to come by; students are often faced with long office hours queues and low instructor support due to staffing shortages. In addition to this feeling of disconnect, students may also face hesitation in asking instructors for academic support or assignment extensions due to perceived or actual stigma, even if it might positively contribute to better success or mental well-being [7]. This leads to the hypothesis that students faced with extenuating circumstances may opt to simply forego assessments when faced with strict deadlines, resulting in diminished learning experiences [8]–[10].

To scale this approach, we present a new strategy called *Flexextensions* that employs automated extension tools. This strategy streamlines instructor and administrative workload and enhances personalized student support in large enrollment courses through automating the request, approval, and management processes of tracking student extensions [11]. The tool employs automation in two ways, by sending automatic confirmation emails and connecting approved extensions to the Gradescope assignment submission software.

This paper studies the effectiveness of automated extensions in reducing barriers to the timely completion of assignments to improve student learning experiences across several Computer Science (CS) and Data Science (DS) college classrooms. Given the broad scope of this goal, the focus of this work centers around analyzing the tool and policy’s use and reception among students in the Fall 2023 semester of three R-1 Institution DS large enrollment courses. We explore the following research questions: **(RQ1)** What features do automated software need to enable the flexible extension in large higher education classrooms? **(RQ2)** How does *Flexextensions* enable accommodation for different extension policies? **(RQ3)** What are students’ utilization of *Flexextensions* and their reported experiences?

Overall, students mostly used the policy only when needed. Most requested an extension on only one assignment for medical or family emergencies, and few misused the system to “catch up” on work. Students’ perceptions of *Flexextensions* are largely positive, with benefits exceeding well-being, learning outcomes, and overall academic experience.

II. BACKGROUND

A. Equity in Computing Education

Critics of Diversity, Equity, and Inclusion (DEI) efforts in university computing departments nationwide [12] argue that while such efforts are often discussed, they are not adequately nor effectively implemented to enact systemic change. Instructors can inadvertently negatively impact students from different backgrounds when they enforce course policies designed with the “typical” student in mind.

As an example, strict course deadline policies traditionally assume that all students face equal barriers to completing timely work. In reality, students may struggle to meet deadlines for a variety of external reasons, such as disability, physical and mental health, or family circumstances [6]. A flexible deadline policy presents itself as a strategy for tackling inclusive computing education by acknowledging that students face unequal barriers and seeking to mitigate them [13]. This paper addresses this by stressing how to build equitable extension policies directly into the course structure rather than asking students to request exceptions to the rule.

B. Flexible Deadlines in Classrooms

Prior work has reported two common reasons for extension requests in a computing class: conflicting obligations from other curricular requirements (e.g., another course’s assignment) and under-estimation of the assignment requirements (e.g., starting late) [14]. Another study found that undergraduate students who utilized up-to-one-week extensions with no penalty for all assignments produced better quality work under decreased stress [6]. However, implementing such a policy poses an additional challenge when dealing with the added complexity of large enrollment courses at public universities—the aforementioned study was employed in an online, asynchronous course that only had 43 enrolled students and seven open-ended assignments. A practical implementation of this policy at a large R-1 institution thus requires both simplifying the management of extension requests and automating the grading of assignments to avoid requiring excessive administrative effort. This paper explores how utilizing automation, especially in large enrollment courses, may be beneficial in lowering barriers to requesting an extension. We also seek to understand if there are other reasons for extensions beyond the two cited above.

C. Teaching & Learning at Scale

While publications related to equity-based learning have been increasing, research conducted on large enrollment classes has been less frequent [3]. Previous work has presented several strategies that have enabled the effective teaching of these large enrollment computing courses, including increased automation in autograders and infrastructure to provide instant feedback and minimize manual grading, as well as the expansion of TA staffing levels and student support networks [2]. This research presents a way to bridge these student support networks with the increasing prevalence of autograders and automation: when methodically tracked, automated flexible extensions have the opportunity to present students with even more flexibility in deadlines while simultaneously reducing the emotional burden and workload on course staff in processing extension requests individually.

III. THE FLEXTENSIONS TOOL

The *Flexextensions* tool manages flexible assignment deadlines with a student-facing form and an instructor-facing roster tool that grants extensions (Figure 2).

What is your student ID?
What is your name?
(Optional) Are you registered with the disabled students program?
Which assignment would you like an extension on?
How many days would you like an extension for?
Why do you need this extension
Are you working with a partner?

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	email	id	dep	hw1	hw2	p1	p2	p3	email	comment	approval	status	email	status	notes	flush_gradescope
2	email@institution.edu	10								Manually App	In Queue					Auto-approved: sick
3	email@institution.edu	2								Auto Approve	Auto Sent					Auto-approved: midterm
4	email@institution.edu	5	5							Auto Approve	Auto Sent					Auto-approved: missed
5	email@institution.edu	6	3							This extension is Auto Approved	Auto Sent					Auto-approved: covid
6	email@institution.edu	6								Auto Approve	Auto Sent					Auto-approved: family emergency
7	email@institution.edu	2	3							Manually App	Auto Sent					A dip request of food
8	email@institution.edu	10								Pending	Pending App					A dip request of DSP
9	email@institution.edu	20								Manually App	Auto Sent					Student requests: target to submit

Fig. 2. Flextensions Tool: (top) student-facing form questions and (bottom) instructor-facing course roster spreadsheet for managing extension approvals.

Student Extension Requests: A Google Form to request extensions is linked on the front page of the website and the syllabus. This form format lowers the barrier to requesting any sort of extension. Instructors set up the Google Form as part of the tool to include assignment-related questions and also details of the request, such as if the student is registered with the campus accessibility program.

Instructor Review and Approval: The results from the Google Form are piped into a Google Sheet and processed into a student roster. This student roster maps each student to their extension in days per assignment.

A. Flextensions Tool Backend

The tool has additional features: automatic emails to students regarding extensions, instructor notifications of when forms are filled out, and integration with other course tools like Gradescope, an assignment grading submission system.

The brains behind processing form submissions into the student roster spreadsheet, automating emails, and enabling Gradescope extensions are the combination of a Google Apps Script that calls some Google Cloud Functions. In addition to processing form submissions on form submit, the Google Cloud functions process three main actions: student roster processing, dispatching emails, and flushing Gradescope.

When a student submits the Google Form, a trigger calls a function that corresponds to a roster row with that student, adds the number of requested days under that assignment's column, and either automatically emails them and extends the assignment in Gradescope or marks it as pending to be manually reviewed. Additionally, a Slack notification system can notify instructors that either an extension was automatically approved or that a request needs manual review. Once extensions are manually reviewed, emails can be automatically sent by using the dispatch emails action feature, part of the Apps Script, which calls a function through Google Cloud. Flushing Gradescope will recreate all existing extensions in Gradescope. These features address (RQ1), including automation for emails and assignment extensions.

IV. METHODS

Over the past two years, *Flextensions* has been used by over 20,000 students in over 10 CS and DS courses at a large R1 institution in the United States. In Spring 2024, at least 10

introductory and advanced undergraduate courses, comprising over 3000 students, use the tool. However, the tool alone is not sufficient to provide equitable, scaled accommodations to students; what must also exist are clear course policies to support it. Such policies, as described below, directly impact how *Flextensions* is used and perceived by students.

A. Course Policies

This paper will focus on a combination of 3 lower division and upper division courses that leveraged *Flextensions* in Fall 2023: a “freshman-level” intro course composed of mostly majors (*Data 1*), a mezzanine “sophomore/junior-level” course composed of majors and non-majors (*Data 2*), and an advanced, topic-specific “senior-level” courses composed of declared majors only, Data Engineering (*Data Eng*). The policies for these courses vary slightly, but all employ a *Flextensions* policy with some form of automated, guaranteed extensions in combination with the *Flextensions* tool. The flexible extensions pipeline is built into the course assessment structure in advance and is made accessible to all students. These policies differ in a few ways, including late penalties, slip days, and grace periods.

All three course policies automatically grant 2-day extensions to students registered in the campus accessibility program and 0 for others. *Data 2*, however, has a 1 day grace period, equivalent to a 1-day auto-extension. *Data 1* and *Data Eng* accept some late work with penalties. *Data 1* will also drop the lowest two homework and lab assignments. *Data Eng* allows for 9 slip days to be used across assignments, in addition to the *Flextensions* form. For (RQ2), using this tool allows for different policies.

B. Data Collection

Data was collected from each course (*Data 1*, *Data 2*, and *Data Eng*) during the Fall 2023 semester, including three datasets: student requests, student extensions roster, and course evaluations. During the semester, this data was only accessible to instructors and lead TAs. All data used in this work was collected according to Institutional Review Board (IRB) protocols.

V. PRELIMINARY RESULTS

A. Student Perceptions

Across the three courses, 1,376 students (52%) responded to the survey. This consisted of 930 students (74%) from *Data 1*, 290 students (27%) from *Data 2*, and 156 students (55%) from *Data Eng*. Overall, the students who reported being aware of the policy outweighed those who were unaware.

Overall, a positive correlation is observed between positive sentiment towards *Flextensions* and course level. *Data Eng* students have the highest percentage of positive sentiments, while *Data 2* students have the highest percentage of negative sentiments, both in terms of comfort in requesting an extension and their beliefs of the benefits of the policy to learning and academic experiences (Figure 3). These courses have differing *Flextensions* policies, which lead to differing sentiments, but both courses employ the *Flextensions* tool.

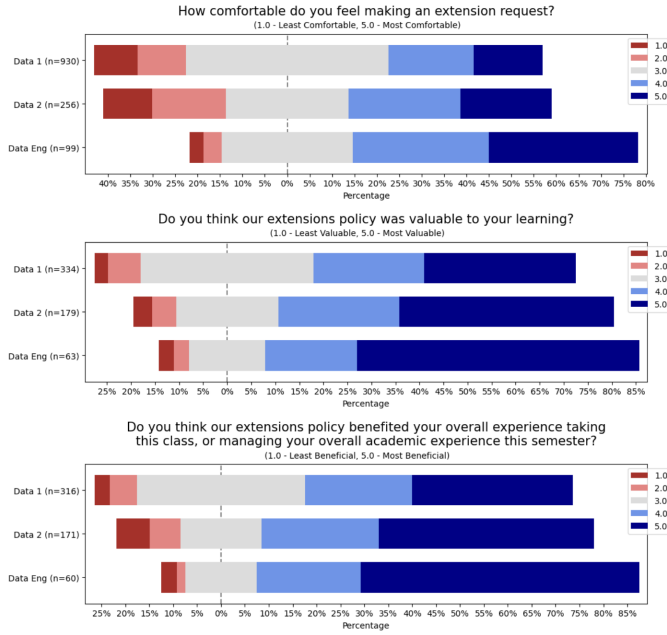


Fig. 3. Survey results regarding policy sentiment

B. Motivations for Extensions

The results presented in Table I illustrate the distribution of requests for various reasons for extension requests. The table showcases the proportion of requests for each theme, expressed as a percentage of the total number of requests.

Addressing (RQ3), students' utilization of the tool is varied across a multitude of categories. Medical-related reasons emerged as the most prevalent theme, constituting 38.00% of all extension requests. Following this, requests stemming from family or personal circumstances accounted for 19.55% of the total. Reasons pertaining to workload represented a smaller portion (14.00%). Another notable portion of requests (10.43%) fell under the category of "Catch-up," which were requests made by students needing extra time to complete the assignment due to falling behind on the material. Technical issues (e.g., internet access for completing assignments), mental health-related reasons, and extracurricular commitments (e.g., university athletics) were found to be less commonly cited as reasons for extension requests, representing only 6.27%, 5.62%, and 0.95% of the total requests, respectively. Requests attributed to disability accounted for 2.48% of the total. Any requests that did not fall under the given themes were categorized as "Other" and constituted 2.70% of the total. Reasons for being classified in the "Other" category included forgetting about the assignment, broadly mentioning an extenuating circumstance without elaboration, or writing text that generally lacked coherence.

The results presented in Table II show the five general themes that emerged while analyzing the qualitative data from the survey responses written by students who chose to share why they were *not* comfortable requesting an extension.

The top two identified themes, which constituted approxi-

TABLE I
COUNT AND PROPORTION OF REQUESTS UNDER EACH REASON.

Theme	Count	%
Medical	521	38.00
Family/Personal Circumstance	268	19.55
Workload	192	14.00
Catch-up Time	143	10.43
Mental Health	77	5.62
Technical Issues	86	6.27
Disability	34	2.48
Extracurricular	13	0.95
Other	37	2.70

TABLE II
COUNT AND PROPORTION OF NON-REQUESTS UNDER EACH REASON

Theme	Count	%
Feelings of doubt, shame, or being undeserving	36	25.71
Fear about being rejected, perceived as lazy or not hardworking	29	20.71
Negative sentiment due to past experience/syllabus wording	29	20.71
Uncertainty or lack of awareness	26	18.57
Personal desire to stick to assignment deadlines	20	14.29

mately 46.42% of the reasons, revolve around psychological barriers that prevented students from seeking additional time to complete their work. Students across all three courses who reported being uncomfortable asking for an extension wrote about feeling "guilty," "ashamed," "embarrassed," "awkward," "undeserving," "intimidated," or that their circumstances would not be "good enough," "believed" or deemed as "qualified" for an extension. For others, it was a "matter of pride," "irrational inner judgment," "a feeling of personal failure" if they ask for help, or "a feeling that no one else is taking extensions so [they] shouldn't either." Students were also concerned about how extensions would reflect negatively on their character, saying they "did not want to be mistaken as not hardworking" or feared it would "lower [their] grade." Many students also mentioned being "scared," having a "fear of rejection" or a "fear of confrontation," assuming their request would not be approved or that there would be a "lack of understanding from instructors."

Reasons pertaining to negative sentiment due to past experiences or syllabus wording represented 20.71% of the responses, of which Data 2 students almost unanimously comprised. Having uncertainty or a lack of awareness about the policy (18.57%) was mostly Data 1 students, which aligns with the results from Figure 3.

VI. DISCUSSION

Across 2,633 students, 25 Data 1 assignments, 27 Data 2 assignments, and 9 Data Eng assignments, there were $2633 \times (25 + 27 + 9) = 160,613$ opportunities to request an extension. Through summing all extension requests, a total of only 1,914 requests (less than 2% of all opportunities) were used, and a majority of students who used the policy used it on only one assignment; the results suggest that most students were not requesting extensions frivolously just because they were given the opportunity to do so.

For (RQ3), student feedback about the value of the *Flex-tensions* was generally positive. Amongst those who chose to elaborate on their experiences in the survey, the qualitative data underscores the positive impact that the extension policy had on student well-being, learning outcomes, and overall academic experience. A significant proportion of respondents emphasized how the policy made them feel valued as individuals, not just students, and appreciated the leniency and flexibility it offered. These observations are consistent with prior work [6]: Flexible deadlines do not lower educational standards, contrary to what some educators who advocate for rigid deadlines are concerned about; rather, they enable students—especially those struggling with juggling coursework with external life circumstances—to engage more deeply with course material and submit higher-quality assignments while simultaneously maintaining their mental well-being, similar previously published work.

The findings illustrate the diversity of challenges that students encounter over a semester. Workload-related reasons constituted a significant portion of extension requests (24.43%), tracking well with prior work. This finding indicates that a non-trivial amount of students struggle to manage competing academic demands within the constraints of traditional deadlines. However, the most significant proportion of requests in this study (38.34%) stemmed from unexpected circumstances, such as medical emergencies, chronic health conditions, or personal crises. This highlights the necessity for compassionate and inclusive approaches to student support that recognize the diverse and unpredictable challenges students may encounter outside of academia, ensuring that students are not penalized for circumstances beyond their control. Furthermore, while *Flex-tensions* may alleviate some academic pressure, underlying systemic issues within academia contribute to the need for extensions in the first place. Instructors should consider strategies for workload distribution and assessment design to reduce intensive workloads and promote a more balanced and manageable academic experience for students.

VII. LIMITATIONS AND FUTURE WORK

This approach, which requires students to disclose a reason for a request, may encourage some students to fabricate an excuse in order to be more likely to receive an extension [15]. A limitation of the perception part of the study is that students self-selected to participate in the survey and self-reported. 46.4% of all survey respondents reported using the policy, compared to the 22.5% of overall students who actually used the policy during the semester. This indicates that students who used the policy are more likely to participate in the survey, which may overemphasize the policy's impact compared to its actual effect on the student body. Additionally, all courses listed are CS or DS, though not all participants hail from those majors (except Data Eng); results might vary among students in other areas of study. Both limitations could skew the perceived impact of the policy; in the future, a method to mitigate this bias or a statistical adjustment should be considered to ensure a balanced representation.

Other future work includes plans to expand use of *Flex-tensions* in courses outside of CS, DS, and this university. Additionally, we intend to explore the long-term academic impacts of *Flex-tensions* as well as the impact of psychological barriers, both individual and systemic [16]. Overall, students benefit from a *Flex-tensions* policy and tool implementation. By automating emails and assignment extensions in the *Flex-tensions* strategy, it is possible to scale up these accommodations for a variety of large courses in higher education.

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