

# Students' Perceptions and Behavior Related to Second-Chance Testing

Chinedu Emeka  
Computer Science  
University of Illinois  
Urbana, IL USA  
cemeka2@illinois.edu

Timothy Bretl  
Aerospace Engineering  
University of Illinois  
Urbana, IL USA  
tbretl@illinois.edu

Geoffrey Herman  
Computer Science  
University of Illinois  
Urbana, IL USA  
glherman@illinois.edu

Matthew West  
Mechanical Science & Engineering  
University of Illinois  
Urbana, IL USA  
mwest@illinois.edu

Craig Zilles  
Computer Science  
University of Illinois  
Urbana, IL USA  
zilles@illinois.edu

**Abstract**—This full research paper explores students' attitudes toward second-chance testing and how second-chance testing influences students' behavior. Second-chance testing refers to giving students the opportunity to take a second instance of each exam for some sort of grade replacement. Previous work has demonstrated that second-chance testing can lead to improved student outcomes in courses, but how to best structure second-chance testing to maximize its benefits remains an open question. We complement previous work by interviewing a diverse group of 23 students that have taken courses that use second-chance testing. From the interviews, we sought to gain insight into students' views and use of second-chance testing. We found that second-chance testing was almost universally viewed positively by the students and was frequently cited as helping to reduce test takers' anxiety and boost their confidence. Overall, we find that the majority of students prepare for second-chance exams in desirable ways, but we also note ways in which second-chance testing can potentially lead to undesirable behaviors including procrastination, overreliance on memorization, and attempts to game the system. We identified emergent themes pertaining to various facets of second-chance test-taking, including: 1) concerns about the time commitment required for second-chance exams; 2) a belief that second-chance exams promoted fairness; and 3) how second-chance testing incentivized learning. This paper will provide instructors and other stakeholders with detailed insights into students' behavior regarding second-chance testing, enabling instructors to develop better policies and avoid unintended consequences.

**Index Terms**—formative, assessments, learning, second-chance testing

## I. INTRODUCTION

In typical courses, students are given one-shot exams as summative assessments to measure learning. Courses simply move ahead with covering new content irrespective of students' performance on assessments. There is little to no incentive for students to rework or revisit material to correct deficiencies in their understanding of course concepts. They can fall behind in class if the content is cumulative. With one-shot exams, students may miss out on opportunities to learn via testing.

Testing can improve learning both directly and indirectly [1]. In lab studies, learning and retention have both been improved when students retest on the same concepts [2]–[4]. Known as the testing effect, testing increases the likelihood of successful retrieval in the future because of the mnemonic effects of repeated recall [1], [3]. Additionally, testing can promote learning indirectly by improving encodings after failed retrieval attempts [1], [5].

When compared to one-shot testing, second-chance testing is better suited to potentially promote learning [6], [7]. Second-chance testing refers to giving students the opportunity to take a second instance of an exam for some sort of grade replacement. Second-chance testing may be characterized as an approximation to mastery-based testing [8]. Previous work has shown that second-chance testing can lead to improvements in students' performance [6], [7], but how to best structure second-chance testing to maximize its benefits remains an open question. Furthermore, little is known about how it affects students' attitudes and behavior. Our study provides insights into second-chance testing by addressing three research questions:

- Research Question 1: What are students' perceptions of second-chance testing?
- Research Question 2: What impacts do students perceive second-chance testing to have on their cognitive and non-cognitive outcomes?
- Research Question 3: How do students describe how they prepare for second-chance testing?

To answer our research questions, we interviewed students who took second-chance exams to learn more about how they reason about second-chance testing and approach studying for courses that offered second-chance tests. Our study explores various facets of second-chance exams beyond their impact on students' grades.

## II. BACKGROUND - SECOND-CHANCE TESTING

In this section, we explain the concepts required to understand second-chance testing.

**Two exams:** Second-chance testing typically involves exactly two exams. These tests are known as the first-chance and second-chance exams. The exams are generally similar in format and topical coverage. For the second-chance exams, most instructors used new questions that covered the same concepts assessed on the first chance. Some instructors used the same questions from the first-chance exams, but varied numbers and variable names. Students knew their grades and received feedback before taking the second-chance exam.

**First-chance exam:** This is the initial and primary version of an exam. Though none of the courses in our study mandate that first-chance exams be taken, these exams were virtually always taken by all students.

**Second-chance exam:** This is an optional second version of an exam. It is a retake opportunity for an assessment that is regularly offered. Our definition only includes courses that specified that assessments would have retake opportunities at the beginning of a semester; instances where a retake test was spontaneously offered for some reason (e.g. due to low performance of a class on an assessment) were not considered as second-chance testing.

**Grading policy:** A grading policy refers to how scores from a first-chance exam and second-chance exam are combined to obtain a student's final score for a given assessment. For instance, one course from this study used a simple average of the two scores to obtain a student's final score for an assessment. More commonly, policies put a higher weight on the higher score, such as by using 90% of a student's higher score and 10% of a student's lower score. It is worth noting that no course had a full grade replacement policy; first-chance exams always counted in grade calculations. As mentioned in Section VI, this is to discourage procrastination. This means that it was impossible for students to get 100% on an assessment if they lost points on a first-chance exam. For all courses, if a student did not take a second-chance exam, the student's score on the first try was used as the final score for an assessment. No course in our study mandated that students take second-chance exams.

**Grade protection:** Grade protection is a feature of some grading policies. If a course offers grade protection, a student's overall score for an assessment is guaranteed to be at least as good as the student's performance on the first-chance exam. This means that if a student performs worse on their second try for an assessment, the student's score will simply be whatever was earned on the first-chance exam. Grade protection may also be thought of as "insurance" or a "safety net."

## III. RELATED WORK

Two main theoretical results motivate second-chance testing: the testing effect and test-potentiated learning. According to the testing effect, retrieval of information (i.e. taking a test) leads to better retention in long-term memory than re-reading

course material [9]. According to test-potentiated learning, re-studying information following a retrieval attempt leads to better persistence of that information in long-term memory [1], [10]. Second-chance testing may help improve not only recall, but a student's ability to benefit from restudying material in the future.

Second-chance testing has been deployed by a number of instructors in order to leverage the benefits of both the testing effect and test-potentiated learning [6], [7], [11].

There are two papers that are closely related to our work on exploring the impacts of second-chance testing on student performance and behavior. In the first study, aggregate student performance, as measured by grades and drop-fail-withdraw rates, improved after second-chance exams were implemented [7]. The second-chance exams were spaced from the first-chance exams by about one week and generally included feedback to students that they could use for remediation. Instructors took steps to ensure that improvements in performance were not due to students "rolling the dice" and hoping they could get a higher score on their second try. The instructors implemented grading policies that they believed would incentivize students to work hard on their first try for exams, such as limiting the amount of points students could earn back on their second try. To determine if student behavior changed after second-chance exams were introduced, the researchers compared performance of students who took a first-chance exam knowing they had a second-chance to students who took one-shot exams in a semester when second-chance exams were not implemented. They found no differences in performance or time spent studying for the first-chance exams between the two groups of students. Students spent roughly the same amount of time preparing for their first try, irrespective of whether they had a second-chance exam or not. The researchers also found that grading policies have a significant impact on which students choose to take the second-chance exam. However, it is not clear if other factors beyond grading policy and initial grade influence student behavior.

In another study [6], researchers further explored the impact of specific grading policies on student performance and retake decisions. One instructor taught all offerings of a course but varied the grading policies across three sections. The researchers found that changes in exam policies mainly affected whether students with an A or B grade would take second-chance tests. Changes in policy had little effect on whether students with a D or F would take second-chance exams. The researchers also examined how grading policies influenced students' exam preparation. The number of practice exams the students took in a learning system was used as a proxy for students' studying and exam preparation. The researchers found no significant differences in preparation based on grading policies, but they did find that preparation for first-chance and second-chance exams differed significantly for students who took both exams. The study focuses primarily on how grading policies influence student behavior and performance, but there may be other features of second-chance tests that affect both students' behavior and outcomes. The researchers

called for additional work that studies how second-chance testing influences test anxiety, among other things.

Further work is needed to better understand how second-chance testing impacts students across various dimensions of interest, such as initial preparation and remediation. Previous quantitative studies do not give us the full picture about students' beliefs and strategies for approaching second-chance tests. This information is critical to enable instructors to deploy second-chance testing for maximal benefit. We aim to fill this gap with our work.

#### IV. DATA AND METHODS

This study was conducted at a large public US university. We identified courses at our institution which had offered second-chance exams in past semesters. The courses were in the following departments: Aerospace Engineering, Computer Science, Electrical and Computer Engineering, Chemistry, and Mechanical Science & Engineering. We sent out an email asking for participants from those courses, with Institutional Review Board approval. We received responses from 23 students and interviewed them; 7 were sophomores, 11 were juniors, and 2 were seniors. Two students did not provide class year information. The students were predominantly engineering majors. Thirteen out of the 23 students had taken two courses that had second-chance exams, while ten students had taken only one course that had second-chance exams. Students were compensated \$20 an hour for participating in the study, prorated by the time spent interviewing. On average, each interview lasted for 30 minutes. The interviews were conducted through teleconferencing, using Zoom.

During the interviews, we asked students a variety of questions related to their experience with second-chance testing, including; 1) their general sentiments regarding second-chance testing; 2) what factors led them to retake tests and 3) how second-chance testing affected their preparation for assessments in general. The interviews were conducted in Fall 2020 and focused mostly on students' experiences with second-chance testing in the Spring 2020 semester.

The interviews were recorded and transcribed for analysis. Subsequently, two researchers independently and inductively coded the transcripts [12]. In this stage, a large number of codes was recorded to retain the nuance of different student experiences. The two researchers reconciled codes after annotating the interview transcripts. These initial codes were consolidated to 19 codes that were used for validation purposes. The two researchers and an external coder re-coded two randomly selected transcripts in order to ascertain inter-rater reliability. Krippendorff's  $\alpha$  was used to measure the inter-rater reliability of the code book [13]. For the computation, we examined whether raters had assigned the same codes for a student's entire response to a question (i.e. an interviewee turn in the conversation) [14]. Krippendorff's  $\alpha$  was found to be satisfactory ( $\alpha = 0.69$ ). The two researchers independently identified themes from the codes and reconciled differences to produce a final list of themes.

#### V. RESULTS

Themes emerged from the student comments. Some of the themes were contradictory, which indicates that there are at least two groups of students with distinct views on, and reactions to, second-chance testing. The list of themes is presented here, with supporting excerpts from the transcripts. We lightly edited the students' comments for clarity by removing filler words and correcting grammatical errors without changing the meaning of the text.

##### A. Overall Second-Chance Sentiment

This section describes the general sentiments students had about second-chance testing. It also explores the impact of second-chance testing on both cognitive and non-cognitive outcomes. We identified seven themes, the majority of which were positive. RQ1 and RQ2 are addressed by the themes in this section.

**Stress reduction:** A large number of students indicated that second-chance testing alleviated stress or anxiety for them.

"The opportunity to have a second-chance exam, lets you not only learn the material more, but also relieves stress."

"I liked it a lot [when classes offered second-chance exams]. I think it gave, it relieved a lot of the stress of taking a CBTF<sup>1</sup> exam."

Even students who did not take second-chance tests reported that knowing they had a second test as a backup option reduced their stress.

"What I thought was it was a very good option to have so it was never too stressful and because of that I don't know if it was because of that, but I ended up not needing them at all."

**Improved learning:** Many students said that second-chance exams improved their learning due to repeated exposure to the same concepts and the fact that it encourages students to spend additional time studying.

"I was able to learn the information better overall and retain the information better overall as a result of second-chance exams."

"I think it definitely better helped me understand the material. And helped me do better academically. So I think it was good in both ways."

"It gives you more incentive to practice the material multiple weeks in a row, especially if you didn't get the grade that you wanted first time around."

"I think it also exposes you to more problems. And I mean there is no such thing as doing too many problems."

Second-chance testing also allows for signalling which topics are important and also gives students extra opportunities to modify their studying and learning strategies. It helps with both learning and meta-cognition.

<sup>1</sup>Many of the courses that use second-chance testing run their exams through the Computer-Based Testing Facility (CBTF) [15]–[17].

“But at least now that I know that this specific concept is going to be tested, I can focus my studying towards this concept rather than just reviewing over it like every other concept and then I can know that, OK, now I need to remember to especially focus on this concept because this is something that’s difficult.”

**Flexibility:** A large number of students stated that second-chance exams provided flexibility for them, allowing them to balance out their workloads or decide which courses to focus on for a specific week. Not all courses offered second-chance exams, so the students noted that they could prioritize a course without second-chance testing on one week and then spend more time on their other course the next week.

“If you were busy a certain week and you just had three exams in a row ... it could become a matter of priorities ... Spend a little less time studying for [the first-chance] ... maybe score a few points lower, but then know that the next week you could retake it and potentially move up to a higher score and you could just manage your time better.”

“It was a really hectic week and I had a project for one of my classes due that weekend. I had the [course 1] midterm. And I had the exam three for [course 2], so I decided to focus on the [course 1] and the project, and because I knew it was an option to do the second-chance testing for [course 2]. So I was like, I’ll just schedule it after my exam and if I’m able to get a good score from an hour of studying, that’s OK. But I knew that I wouldn’t score well on the exam and that I would have to take the second-chance testing.”

**Improved grades:** Many students indicated that second-chance exams helped them improve their performance in courses that offered them.

“I would definitely say that [second-chance exams] help your academic goals, ’cause honestly, they definitely help your grade out in the class.”

One student even stated that they would not have passed a course without second-chance exams.

“Yeah, I think I probably wouldn’t have done that well. Well, I didn’t do great in the class. I got a C, but I passed it and, to be honest, I probably wouldn’t have passed the class without second-chance exams.”

**Reliable assessment:** Many students indicated that second-chance testing mitigates exam variance. The exam variance that students mentioned could be internal (e.g. variations in performance due to personal circumstances such as sickness) or external (such as exam versioning). Exam versioning was common in many of the courses which offered second-chance exams.

“I felt it gave me a chance to redeem myself, one, and two, really know like what sections were the hardest for me. Also, at least for that class, they have

random questions for everyone. So some people end up with really, really difficult, really hard questions compared to other people who get really, really easy questions which feels pretty unfair ... ’cause we’re not supposed to, but we tell each other which questions we got and I would almost always get some of the hardest questions from the homework. So I felt getting the second chance is nice because if I got that like really hard question again, at least I knew ahead of time. Like how much time I should spend on the problem. And when I should give up or not.”

“And, because we’re all college students, we have so many things going on that a lot of the times, one exam isn’t definitive of how we actually know that material. So having that opportunity [to take a second-chance exam], lets not only the students prove that they know what the professor is trying to teach, but also that they can learn pretty quickly as well.”

Additionally, second-chance testing also helped mitigate variance in performance that resulted from shorter exams.

“There’s only 6 to 10 questions throughout the entire quiz. So if you get one wrong, it really hinders your grade overall on that quiz ... So then, so let’s say I did get a question wrong and let’s say I got everything else right, getting that one question wrong, could you bring my grade from, let’s say, like 100% potentially on that quiz to a 75%. It’s a big—I’m just trying to emphasize that—it’s a big kind of effect on your grade. So then, let’s say that does happen, the second time around, I kind of go in there more hopeful being able to think like, ’OK, I know what I did wrong the first time.’ I’ve studied what I got wrong. I kind of understood the concept. Maybe I applied an equation incorrectly. I kind of make sure that I remember the wording of the problem, so as soon as I’m done with that testing and go home, I’ll write it down and then kind of work through what I did wrong until I believe I find the correct answer and I know in office hours after two or three days of the quiz, you can go into office hours and talk to the teaching assistants about it. So I did do that and I walked through the problem and the second time around I did get a better score [and my] overall grade for that quiz did improve.”

**Helpful:** Overall, a large majority of the students we interviewed stated that they liked second-chance exams, with some expressing the desire for more courses to use second-chance exams.

“I wanted to actually talk to you about second-chance exams because they’ve been very helpful for me throughout my engineering studies, especially for [course name].”

“Yeah, I liked [when courses offered second-chance exams] a lot, especially in [course number] when it was like, I’ve never done a lot of the coursework because there’s really brand new stuff.”

“I wish all classes offered second-chance exams.”

**Drawbacks:** Even though second-chance exams were optional, a few students expressed dissatisfaction with second-chance testing and listed specific issues they had. Most notably, two students mentioned that they felt pressured to do the retakes.

“I found [second-chance exams] to be really stressful most of the time. If I got a really low score, it was really nice to be able to get a second chance, but any time where I got like a score in the 80s, in the B range, I would still feel pressured to retake it because if I did worse, it wouldn’t affect me, so I felt like I had to retake it just to see if I could do better. But that was really time consuming because it took an hour out of each week for me. Instead of having just one quiz every two weeks. I would feel pressured to retake it and then it was basically a quiz every single week.”

### *B. Factors Influencing Retake Decision*

In this section, we report on the students’ primary considerations when taking second-chance exams. According to the literature and previous quantitative analysis, students’ scores on first-chance exams are a significant factor that influences whether they take the second-chance exam. However, it does not explain all of the variance in students’ decision making. We confirm previous results here, and also present three other factors that groups of students stated they considered.

**Score is primary factor in retake decision:** Many students stated that their score on the first-chance exam was the main factor they considered when deciding whether to retake an exam or not.

“Obviously it was the outcome of the first that impacted my decision to take the second test. I would, based on how my first test went, I would say, ‘Is this the grade I want for this given exam?’ And if not, is it going to set me back so much of my grade that I need to take a second chance? And that’s majority of the decision.”

“So usually I’d—based on the grade I’d get—I would take the retry.”

“If I got anywhere below like a 90—which I usually did—I would retake it.”

Typically, students indicated that they would not retake exams if they earned a high enough grade. Conversely, they would retake exams if they considered their scores low. What was considered a high enough score varied by student: for some, it was a B grade, and for others, it was an A grade.

“If I had an A on the first exam, then I wouldn’t take a second one. If I had a B, then it kind of depends where my grade is at. Usually, if it’s around a C or lower, that’s when I would for sure take a second one to try and boost my grade up.”

**Confidence affects retake decision:** Many students who said that their grade influenced their retake decision also stated that their belief in their ability to do better played a part in their decision making. Even if there was no risk of students’ grades going down, they were still hesitant to take a second-chance exam if they were not reasonably sure of improvement, presumably because of the time required.

“If I don’t think I can get a much higher grade, I don’t think second-chance testing for me would be worth it. But if I think that in that one week, I have enough time to . . . look at my mistakes and do better, then why wouldn’t I?”

“If I think I wouldn’t be able to get a better score than my first exam, I wouldn’t take it.”

“I got a 90% on the exam but I still took the retake even if it could lower my grade, well, one because I got a 96% because I did something really stupid . . . But then I felt confident enough to get 100 on the second-chance exam ”

“I always took [the second-chance exam] because I thought there was no reason they could harm me by taking it other than the fact that it just takes time. I think maybe there were one or two cases in which I simply did not have the time to study it, and I did not have the time to go retake it when my efforts would be fruitless, so to speak, because I just did not have enough time to sort of refresh and retain that material. So I would just skip the retake for that week.”

**Considerations about time affect retake decision:** A small number of students mentioned that time available to study influenced their retake decisions. Those students indicated that even if they were offered a retake exam with no risk of their scores going down, they would still consider commitments and time constraints when deciding whether to retake an exam.

“There was maybe once or twice when I wasn’t able to take the retake just because I had other exams that I prioritized. I was like, oh OK, a 70 is fine, it’s not ideal, but I don’t have the time to fix it. I need to focus on other exams.”

“It was the score, but also if I had events that I had prior committed to, such as meetings for clubs or extra-curriculars. I would also prioritize those over the retake, probably”

**Protection encourages retakes:** For some courses, students were guaranteed their first score or better, i.e. if they earned a lower score on the second-chance exam than they did on the first-chance exam, the score from the first try was used as their assessment score. Students frequently reported that grade protection encouraged them to attempt the retakes.

“You can see what you need to get an ... A or B, but most of the time, I would be leaning toward just taking the second-chance exam, especially in [course name] because they could never hurt my grade. So, I took every single one of the retakes, 'cause I wasn't doing too well in the class.”

Some students with high scores also did the retakes to get additional practice or for “fun.”

“I'm not gonna lie, I pretty much took the second exam every single time because as I said, if you scored lower, your original score wasn't affected, so I saw no reason to not take the exam every time. So I would just take it. And if I had scored well on the first exam, if I had scored above a 90 on my first try, I probably wouldn't study that much for the second. I would just go in and see if I could maybe get a few extra points, not worry about it too much, but I would pretty much take it every time, no matter what score I got on the first exam.”

“I don't know how to tell you this, but I was taking them because I didn't have anything to lose.”

### C. Impact of Second Chance On Study Habits

A goal of second-chance testing, and mastery-based learning more broadly, is to encourage students to fix deficiencies in their understanding of course concepts. In this section, we present four themes from the data that explain how second-chance testing impacts remediation. RQ3 is addressed by the themes in this section. The section also clarifies how second-chance testing influences students' studying, which may be of interest to instructors when they are determining the grading policies for their courses.

**Serious studying for the first chance:** Despite the fact that students could potentially recoup some or most of the lost points during a second-chance exam, students frequently stated that they studied seriously for the first try.

“I'm a pretty diligent studier so I studied pretty hard for [the first-chance exam].”

“If this course does not offer second chances, I would still prepare as many hours as I would prepare for the first time ... if this course offers second chances, I might prepare [for] a first time exam for five hours and maybe [for] two hours for the second chance, but if they don't offer a second chance, I still only prepare [for] five hours for the first time.”

Some students explained that they studied hard for the first try because that was the best way to maximize their overall performance on an assessment because the first-chance exam scores were used in the assessments' final score calculation. For example, the only way for a student to get a perfect score would be to get a 100% on the first-chance exam.

“I tried to not let it influence the way I prepare ... Some students do, but personally I just try to study as if it's like a regular exam and do my absolute best

... 'cause I know the lower score still counts towards my grade for the class.”

“I would study, I think, about equally [for the first and second chance exam] because if you get a really low score on the first exam, but a really high one [on the second exam], the average [for the final assessment's score] is still a low one.”

“I usually try to study for the first round and do as well as I could on that one, 'cause even if I did bad but then got a good grade on the second chance one, I still would've done as well if I [had] just done well the first time, if that makes sense. I try to do well the first time.”

**Reduced studying for first exam:** For a second group of students, the knowledge that they would get a second try led these students to study less for the first chance. For some students, this could be characterized as procrastination.

“I guess it affected my study. I guess I can say I studied less because I could always take the second exam.”

“I would say there is a downside of taking second chance because ... several of my other friends in this class, they ... would do absolutely horrible on the first one because they know that they are given the second chance ... because you can say: 'OK, quiz is tomorrow but I got a second-chance [test] next week, so I don't really have to study tonight for that quiz.' And then they just kind of ... bomb it.”

Other students seemed to study less for the first-chance exam because they seemed to be optimizing their score for a certain studying budget by saving more of their studying for when they have more information about the exam.

“So I use the the first chance more as to ... I went over all like the topics and tr[ie]d to get a gauge on what exactly I would be testing on. And then I went into the [exam] a little bit under-prepared but I recognize the kind of ... exact way that I was going to be tested on it and I was much more able to be prepared the second time I tested because I knew the way in which it was going to be asked.”

**Targeted remediation:** Many students commented that the approach they took for studying for first and second-chance exams differed. Typically, students studied broadly for first-chance exams. In contrast, students frequently expressed that they would focus their studying for the second-chance exam on areas they got wrong the first time.

“The questions I got wrong the first time were the things that I focused on the most [when studying for the second-chance exam]. Cause I generally studied most of the material on the first exam.”

“I always look for what I couldn't do on the first exam and that would guide me, kind of give me an idea of what I'm not understanding well in the course material. So I would just review that question

or it's related topics or whatever. If I studied well for the first exam—and for me it was always the case—I would just review the points that I missed in the first exam [in preparation for the second-chance exam]”. “I think second exams help. Like the first one help[s] pinpoint where my fault lies, and then I would be able to study on those subjects more and then do the retake and get a better score.”

**Encouraged use of course resources:** As part of their targeted remediation, students frequently reported seeking out course staff, going to office hours, or studying with friends.

“You can go to office hours. And you can go and review the problem you got wrong with the TA. They can walk you through it. See what you got wrong and you could kind of analyze... And then you kind of review that problem you got wrong... So now in that case I said OK, I see what I did wrong. I'll address it, fix it, and now I know not to make that same mistake the second time around.”

“OK, this was what I got wrong on the quiz. Maybe I don't know the exact answer, but what I can do is I can understand, OK, if this is the type of question, maybe I can go either ask the professor in the time that I have, ‘professor could you explain specifically how to pursue this type of question?’ Or maybe I could ask a TA or maybe a tutor...”

#### *D. Perceptions of faculty goals*

**Positive impressions about professors:** Students frequently indicated that they believe professors are offering second-chance exams in order to reduce student stress, accommodate various life events, and ensure that students' scores accurately reflect the students' knowledge of concepts.

“I would assume that the logic behind it is just that, you know, learning the material is more important than your score on the exam. In the end, you know the goal is to actually learn the material that is being taught. So by offering a second-chance exam, you give the students an opportunity to demonstrate that even though they might have messed up or made some mistakes on the first topic, they actually did understand and learn the material and therefore deserve a higher grade on this particular assessment, if they desire to take it.”

“I think to give us another option to show our abilities and I believe they understand, especially [course names] that the class material is already hard and life can sometimes put some stuff ahead of you ... Let's say I had this exam this week and I broke my leg, right? And I know this is like an exceptional case, but I have a second chance next week to retake that exam even if I failed this one or couldn't take this one. So in general, I guess I'm trying to say that they understand us and they just want to give us a second chance to show our abilities, like I said earlier.”

Students' comments suggest that second-chance testing is achieving the benefits of repeated recall and test-potentiated learning. Students specifically stated that second-chance tests motivated them to review course materials and helped them with long-term retention. They reported that second-chance tests led to improvements in their learning and performance.

Second-chance testing also promoted metacognition among students. Many of the courses in our study which offered second-chance exams were designed for freshmen and sophomore students. These students may not have been accustomed to studying for college level work [18]. Second-chance testing encouraged students to reflect on their study strategies and determine more appropriate methods of studying for their coursework. The majority of students utilized second-chance testing in the ways that faculty want; to identify deficiencies, correct misunderstandings, and mitigate the impact of “bad luck” or personal circumstances on exam performance.

Furthermore, the vast majority of students viewed second-chance exams favorably. Among the specific benefits that students mentioned, stress and anxiety reduction was the most frequent. In fact, stress reduction was more widely cited as a benefit than grade boosts which resulted from second-chance testing. In previous work, test anxiety has been shown to have significant adverse impacts on students' performance [19], [20]. Test anxiety has two components, the emotionality and cognitive (i.e. worry) dimensions [21], but it is the cognitive component that is more often associated with diminished performance [20]. The cognitive component of test anxiety encompasses students considering the consequences of failure and worrying over evaluation. Second-chance testing may reduce test anxiety because of its impact on the cognitive component of test anxiety; second-chance testing helps alleviate students' concerns about not meeting their performance expectations because they know they will be able to get feedback and identify and correct deficiencies. Second-chance exams reduce the stakes of a single assessment. Knowing that they have second-chance exams may make students more confident about their ability to meet their goals.

In our study, students reported second-chance testing as having many benefits, but this result may have been influenced by the contexts in which it was used. Most of the courses we recruited students from had offered second-chance exams for several years, giving the courses time to refine their implementations in light of student behavior. For instance, no course had a full grade replacement policy where students could recoup all lost points (i.e., the first-chance exam always had an impact on a student's overall score, which may have disincentivised procrastination). From interactions with faculty that run these courses, we know of attempts to offer full grade replacement that led to significant procrastination, including students skipping the first exam. Some experimentation may be needed to determine the best policies for a group of students.

## VII. LIMITATIONS AND FUTURE WORK

We identified three main limitations with our work. The first limitation is the sample used for the study. We reached out to hundreds of students, but only 23 students responded and attended interviews; this sample might not be fully representative of students who take second-chance exams at our institution or other schools. In the future, we intend to survey a large number of students and ascertain if the sentiments we noted in the sample are representative of the broader student population.

The second limitation was that students were asked to recall policies and their strategies from a previous semester. From reviewing syllabi, we know that some students misremembered a course's policies. It may be that they also struggled to recall their behavior correctly. To correct for this, when we conduct surveys, we will ask students about courses that they are currently taking.

Finally, the third limitation of our study is that students' sentiments about second-chance tests may have been influenced by specific features of courses they took. When we have more respondents, we will control for differences in sentiment based on courses by analyzing students' behavior and attitudes for each course separately.

## VIII. CONCLUSION

In summary, our study provides evidence that second-chance testing can improve cognitive and non-cognitive outcomes for students. We found that second-chance testing encouraged students' remediation, improved their self-reported learning and boosted their grades. Students viewed instructors who offered second-chance exams favorably, often stating that the professors were compassionate and invested in the students' welfare. Many students still studied seriously for the first-chance exams despite having a retake opportunity. However, a second non-negligible group of students indicated that the presence of second-chance exams led them to reduce their studying for the first-chance exams. This could be a case of rational optimization around priorities, but faculty need to set appropriate policies (e.g. grading policies) to achieve the desired student behavior.

## IX. ACKNOWLEDGEMENTS

This material is based upon work supported by the National Science Foundation under Grant No. 1915257. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

## REFERENCES

- [1] Kathleen M Arnold and Kathleen B McDermott. Test-potentiated learning: Distinguishing between direct and indirect effects of tests. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 39(3):940, 2013.
- [2] Andrew C Butler. Repeated testing produces superior transfer of learning relative to repeated studying. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 36(5):1118, 2010.
- [3] Jeffrey D Karpicke and Henry L Roediger. The critical importance of retrieval for learning. *science*, 319(5865):966–968, 2008.
- [4] Henry L Roediger III and Andrew C Butler. The critical role of retrieval practice in long-term retention. *Trends in cognitive sciences*, 15(1):20–27, 2011.
- [5] Henry L Roediger III, Adam L Putnam, and Megan A Smith. Ten benefits of testing and their applications to educational practice. *Psychology of learning and motivation*, 55:1–36, 2011.
- [6] Geoffrey L Herman, Zhouxiang Cai, Timothy Bretl, Craig Zilles, and Matthew West. Comparison of grade replacement and weighted averages for second-chance exams. In *Proceedings of the 2020 ACM Conference on International Computing Education Research*, pages 56–66, 2020.
- [7] Geoffrey Herman, Kavya Varghese, and Craig Zilles. Second-chance testing course policies and student behavior. In *2019 IEEE Frontiers in Education Conference (FIE)*, pages 1–7. IEEE, 2019.
- [8] Sandra M Juhler, Janice F Rech, Steven G From, and Monica M Brogan. The effect of optional retesting on college students' achievement in an individualized algebra course. *The Journal of experimental education*, 66(2):125–137, 1998.
- [9] Mark A McDaniel, Janis L Anderson, Mary H Derbish, and Nova Morrisette. Testing the testing effect in the classroom. *European journal of cognitive psychology*, 19(4-5):494–513, 2007.
- [10] Chizuko Izawa. Reinforcement-test sequences in paired-associate learning. *Psychological Reports*, 18(3):879–919, 1966.
- [11] Jason W Morpew, Mariana Silva, Geoffrey Herman, and Matthew West. Frequent mastery testing with second-chance exams leads to enhanced student learning in undergraduate engineering. *Applied Cognitive Psychology*, 34(1):168–181, 2020.
- [12] Anselm Strauss and Juliet Corbin. Grounded theory methodology: An overview. 1994.
- [13] Klaus Krippendorff. Agreement and information in the reliability of coding. *Communication Methods and Measures*, 5(2):93–112, 2011.
- [14] Cliodhna O'Connor and Helene Joffe. Intercoder reliability in qualitative research: debates and practical guidelines. *International Journal of Qualitative Methods*, 19:1609406919899220, 2020.
- [15] Craig Zilles, Matthew West, David Mussulman, and Tim Bretl. Making testing less trying: Lessons learned from operating a computer-based testing facility. In *2018 IEEE Frontiers in Education Conference (FIE)*, pages 1–9. IEEE, 2018.
- [16] C. Zilles, R. T. Deloatch, J. Bailey, B. B. Khattar, W. Fagen, C. Heeren, D Mussulman, and M. West. Computerized testing: A vision and initial experiences. In *American Society for Engineering Education (ASEE) Annual Conference*, 2015.
- [17] Craig Zilles, Matthew West, Geoffrey Herman, and Timothy Bretl. Every university should have a computer-based testing facility. In *Proceedings of the 11th International Conference on Computer Supported Education (CSEDU)*, May 2019.
- [18] Christopher D Schmitz, Geoffrey L Herman, and Timothy Bretl. The effects of second-chance testing on learning outcomes in a first-year stem course in engineering. In *ASEE Annual Conference and Exposition, Conference Proceedings*, volume 2020, page 1355, 2020.
- [19] Rizwan Rana and Nasir Mahmood. The relationship between test anxiety and academic achievement. *Bulletin of Education and Research*, 32(2):63–74, 2010.
- [20] J. Cassady and R. E. Johnson. Cognitive test anxiety and academic performance. *Contemporary Educational Psychology*, 27:270–295, 2002.
- [21] Ray Hembree. Correlates, causes, effects, and treatment of test anxiety. *Review of educational research*, 58(1):47–77, 1988.