Enhancing Student Success Using Flexible Assessment

Bryan J. Mealy
California Polytechnic State University, San Luis Obispo

Abstract

This paper describes our continued work with Flexible Assessment (FAST) techniques where we give students options in how assessment affects their final course grade. The primary responsibilities of instructors are to help students learn and to assess what they've learned, which presents a dilemma because the more time instructors spend assessing students reduces the amount of time instructors can spend directly helping students. This notion is particularly important in modern course formats designed to enhance the active learning aspects of the course. In designing and preparing courses, instructors inherently must divide limited class meeting times between assessing students and helping students learn. Assessing student achievement using quizzes and exams is not a learning experience, much less an active learning experience, but many students use such assessment distributed throughout the course as "motivation" to remain current with course material.

This paper builds upon our previous work where we gave students the option of using weekly quizzes to lessen the weight of the final exam. Our new approach allows students to choose to take weekly quizzes; each quiz a student takes reduces the final exam weighting by a fixed percentage. This approach addresses the primary student complaint with our previous approach, which required students to continue with the quiz vs. non-quiz choice they made at the beginning of the course.

Our new FAST approach treats student assessment with a more holistic approach with an overall goal of enhancing student success in the course. The flexibility associated with our approach recognizes that students generally have a wide range of academic and personal responsibilities, which are typically non-flexible in nature. Our intention is to allow students to prioritize their academic schedules without penalizing them for not having adequate time to prepare for a scheduled assessment, which gives them some wiggle-room as they juggle challenging academic schedules.

Introduction

The two main responsibilities of instructors are to 1) help students learn the course material, and 2) assess how well students learned that material. The literature is replete with approaches to enhance teaching[3], including recent innovations in content delivery such as studio formats and flipped classrooms. The many aspects of assessment are also a common topic in the literature[1], which points out assessment supports student learning only under certain conditions[4]. The intention of our work is to enhance these well-documented results by adding student-directed flexibility to the assessment process, and embrace the notion that assessment can have more of an influence on learning than teaching[7].

A common theme in modern approaches to teaching is to give students more responsibility for their own learning. This theme inspires us to shift student responsibility to the assessment

process as well. Shifting the assessment focus can change student attitudes in ways such as encouraging them to take more responsibility for their own learning[11].

Although there is not a large amount of research into flexible assessment, the existing research provides a solid foundation of the topic as well as describing many underlying issues[8,5]. Moreover, this research often examines how flexible assessment techniques affect student motivation, which is a topic we do not directly examine in this paper. Several of the described schemes involve technical electives and general education courses[9], large course enrollments, and computer managed learning[2]. Additionally, these schemes were applied to non-engineering courses such as nutrition, accounting, and quantitative analysis. Our approach to flexible assessment has inherently different requirements in that we applied it to a required lower-division design-based engineering course with a significant lab component, and taught the course in a studio classroom with a flipped course format to a modest number of students (approximately 30 students per section).

Our teaching experience indicates that the standard ideas for assessment experience two major problems. First, students seemed to fall behind learning the course material and then scrambled to catch up before a schedule assessment such as a quiz or exam. Second, no matter how we planned our assessments, they seemed to conflict with assessment activities in the student's other courses, which forces students to divide study time between the courses.

Our new FAST approach gives students options in the assessment process. This approach supports a more holistic view of students and avoids treating students as static homogenous test subjects. We believe that giving students flexibility in the assessment process allows students to better balance other academic time bandits such as academic workload, employment, and personal issues. Additionally, our new approach to flexible assessment is relatively simple so that the options do not cause added stress in students.

Educational research typically does not consider the "whole" student in the context of assessment, which ignores the notion that success in one course may come at the expense of decreased performance in other courses. This issue underscores the fact that instructors have inherent control over student time management based on course workload, which is why we design courses that require a reasonable time commitment but still meet the course's learning objectives. Instructors that require an inordinate amount of student resources in order pass the course place unfair demands on students. We choose to treat our students as the professionals we expect them to be and do not use threats or bribes as a means of enhancing their performance in our course.

Summary of Previous Work

Our previous work describes our first attempt at flexible assessment[6], where we required students to choose to take weekly quizzes or not in the first week of instruction and honor that decision for the entire quarter. We performed this experiment over two sections of an intermediate digital design course; approximately 50% of students chose to take the quiz option. The results showed that non-quiz-taking students performed better than quiz taking students on the course finals and the overall course based on assigned course GPA. The data also showed the lower-performing students performed better when taking the quiz option than their non-quiz taking cohorts. We also reported that 87% of quiz-taking students and 71% of non-quiz-taking students said they would not change their decision to take quizzes or not if given the option to do it again. This

result, combined with the fact that 82% of quiz-taking students reported that quizzes helped them learn the course material, encouraged us to run the experiment again. We re-ran the experiment the following quarter on one section of the same course, but only one student chose the quiz option, which effectively undermined the experiment. As a result, we modified our assessment approach to address the most common student complaint of the approach, which was that students had to either take all the quizzes or no quizzes.

Experiment Description

We conducted our new experiment during the Spring 2018 and Fall 2018 quarters on an introductory digital design course. The course topics included gate-level design, modular design, and a strong emphasis on finite state machine-based circuit design. We taught the course in a studio classroom using a flipped classroom format. We gave students the option to take any number of weekly quizzes, with each quiz representing 2.5% of the final course grade; if a student chose to not take a quiz, we transferred the quiz weighting to the final exams. This new approach is similar to our previous approach in that students could take all or none of the quizzes, but added the flexibility of not taking some quizzes without penalty. The course's studio format provides two exam slots during final exam week, which we used to give a "lab final" and "lecture final". The lab final comprised of approximately 35 short answer questions and definitions, but no design problems; the lecture final comprised of non-trivial design problems. Students had approximately two hours to complete the lab final and three hours to complete the lecture final; less than 20% of the students were present at the end of each final. Table 1 shows example weightings based on various number of quizzes.

	Example Weightings		
Assessment Item	**Ten Quizzes**	**Five Quizzes**	**Zero Quizzes**
Quizzes	25.0%	12.5%	0.0%
Lab Reports	20.0%	20.0%	20.0%
Lab Final Exam	25.0%	30.0%	35.0%
Lecture Final Exam	30.0%	37.5%	45.0%

Table 1: Weightings for three example quiz selections.

A significant aspect of the course were 15 laboratory experiments, where students learned to model circuits using an HDL and implement them on an FPGA-based development board. We placed heavy emphasis on the experiments and subsequent lab reports because they were the main active learning component of the course. All courseware was available to students at no cost, including the development environment supporting the HDL, which allowed students to complete the experiments outside of the lab. Students used VHDL during the spring quarter and Verilog during the fall quarter.

Each of the ten quizzes was two pages in length; the first page was a design problem and the second page had short answer questions. The quizzes matched the format of the two final examinations in that the design problems were similar to the lecture final and the short answer questions were similar to the lab final. We gave students approximately 25 minutes to complete the closed-book and closed note quizzes. The lab reports also included both design-type problems and short-answer questions. We provided immediate feedback by returning graded lab

reports and quizzes the class meeting after students submitted them and gave all students access to the quizzes and solutions after the quiz. Students not taking the quiz could ask questions or work on lab assignments while other students were taking the quiz, which allowed students not taking the quiz to receive more help from instructors and/or teaching assistants than students taking the quiz.

The spring quarter included two sections for a total of 48 students while fall quarter included one section with 30 students. The students were primarily computer (CPE) and electrical engineering students (EE); Table 2 shows the breakdown of student majors for the two quarters.

We used both objective and subjective assessment for the course. The lab final and half of each quiz used objective assessment, where each problem generally has only one answer. A majority of the course assessment, however, was subjective as half the quizzes and the lecture final were comprised of design problems, which inherently have multiple solutions that required grading by a competent human. This subjective assessment allows for the evaluation of problem-solving skills and promotes deep lasting learning[10].

Quarter	# of Students	EE	CPE	GENE
Spring 2018	48	4.2%	95.8%	0%
Fall 2018	30	76.7%	20.0%	3.3%

Table 2: Student majors for Spring and Fall quarters.

Experiment Results

Table 3 shows some pertinent results associated with the experiment. The lab final for both quarters was primarily the same except for a few problems associated with the HDL; the lecture finals were identical. The Avg GPA is the cumulative GPA for students at the start of the course; 30% of the fall quarter students were transfers and had no prior grade history from our institution.

Quarter	Lab Final Avg	Lecture Final Avg	Total Avg	Avg GPA (Cumulative)	Avg GPA (Course)
Spring 2018	62.3%	63.2%	67.4%	3.21	2.21
Fall 2018	65.0%	67.8%	72.9%	3.29	2.43

Table 3: Various experiment statistics for Spring and Fall quarters.

Figure 1 shows the percentage of students taking each quiz. A majority of students started out taking quizzes, but took less as the quarter progressed. Figure 2 shows the average quiz scores for each quiz; the quiz scores for the two quarters are generally similar indicating students in both quarters faced similar challenges during the course. The high scores for the spring quarter in later quizzes resulted from only one high-performing student taking the quiz.

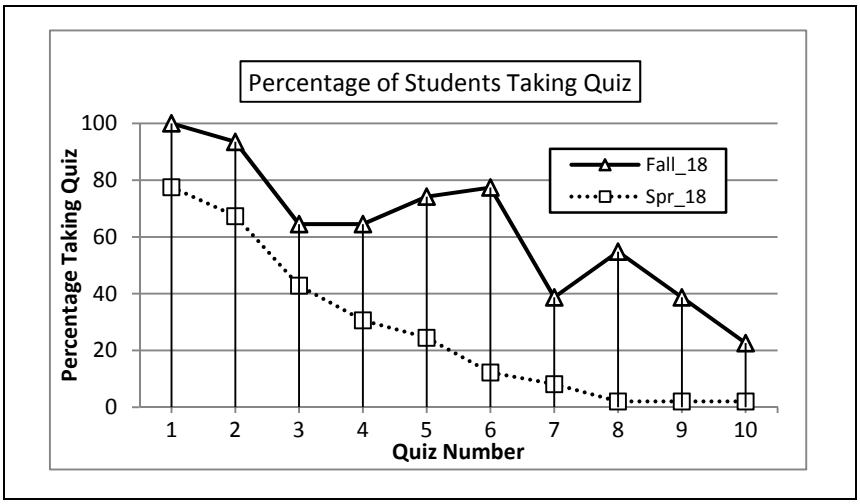

Figure 1: Percentage of students taking individual quizzes.

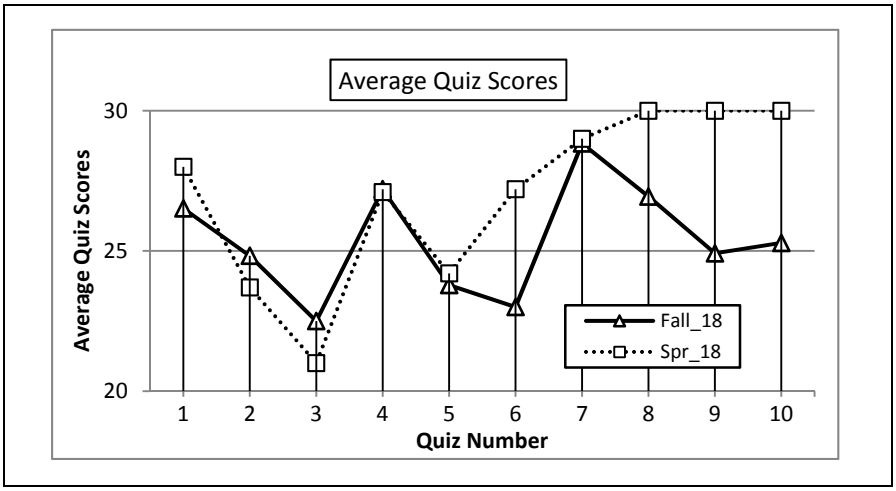

Figure 2: Average quiz scores for each quiz.

Figure 3 shows normalized distributions for each quarter's final grades. The main difference between the distributions is the fall quarter's significantly higher percentage of A grades.

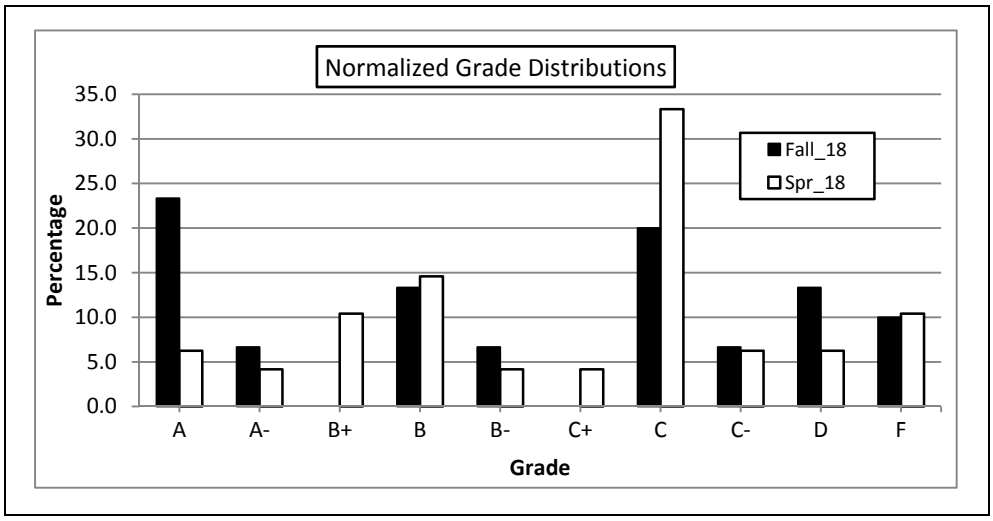

Figure 3: Normalized final grade distributions for both quarters.

Figure 4 shows what percentage of students took a given number of quizzes. All students in the fall quarter took at least two quizzes, while over 20% of students in the spring quarter took one or less quiz. Overall, the students in the spring and fall quarters took an average of 2.7 and 6.0 quizzes, respectively.

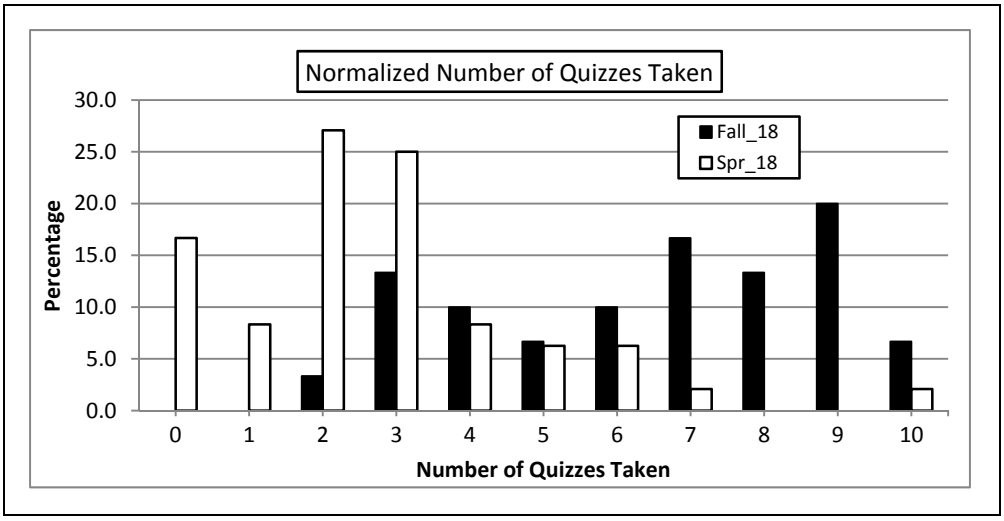

Figure 4: Distribution showing percentage of students taking a given number of quizzes.

Figure 5 shows the average number of quizzes taken by each student as a function of the final course grade. Figure 5 also includes trend lines for each quarter that indicate that higher-performing students took more quizzes. Figure 5 seems to indicate that taking more quizzes enhanced student performance, but Figure 6 shows that this is not necessarily the case. Figure 6 shows the average number of quizzes taken as a function of starting cumulative GPA. Figure 7 and Figure 8 show average number of quizzes taken as a function of lab final and lecture final scores, respectively. Figures 6-8 show a similar trend in that higher-performing students took more quizzes.

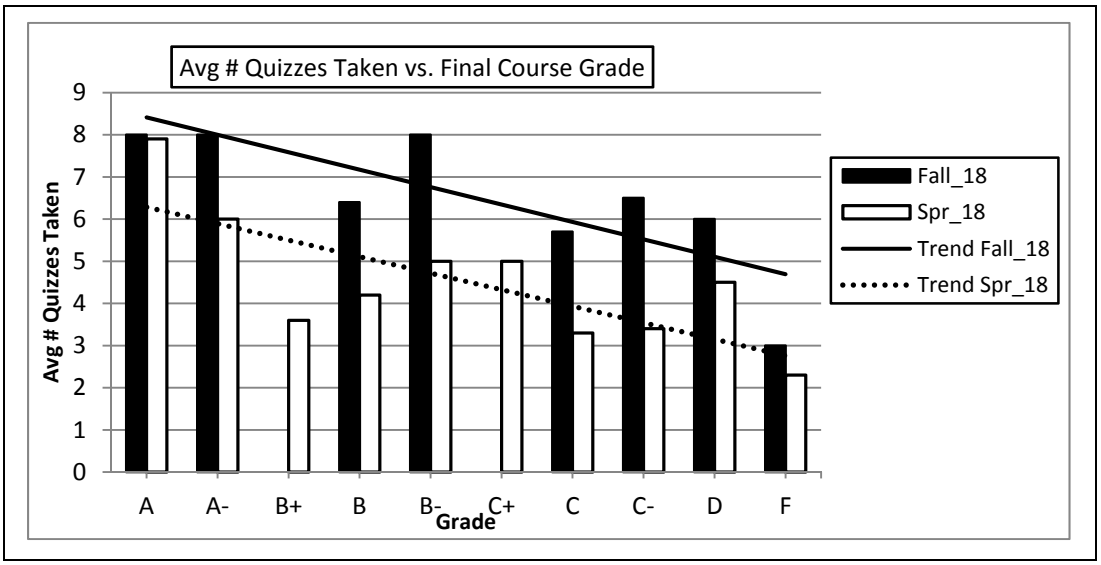

Figure 5: Distribution showing the average number of quizzes taken vs. final course grade.

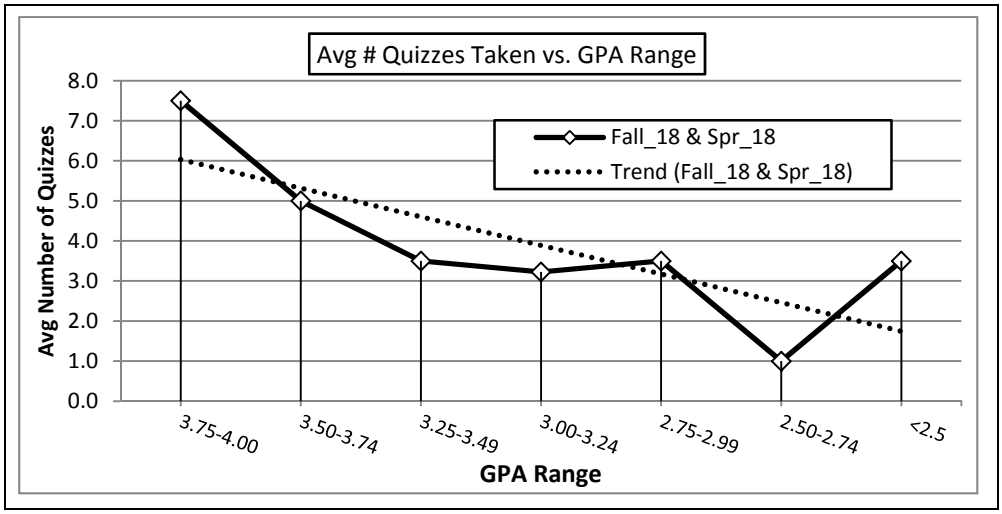

Figure 6: Average number of quizzes taken as function of starting cumulative GPA.

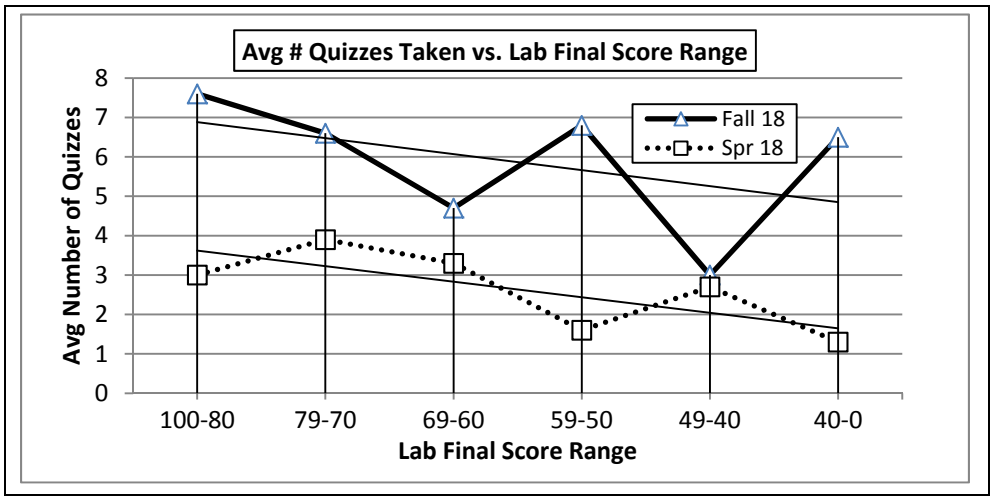

Figure 7: Average number of quizzes taken as a function of lab final score.

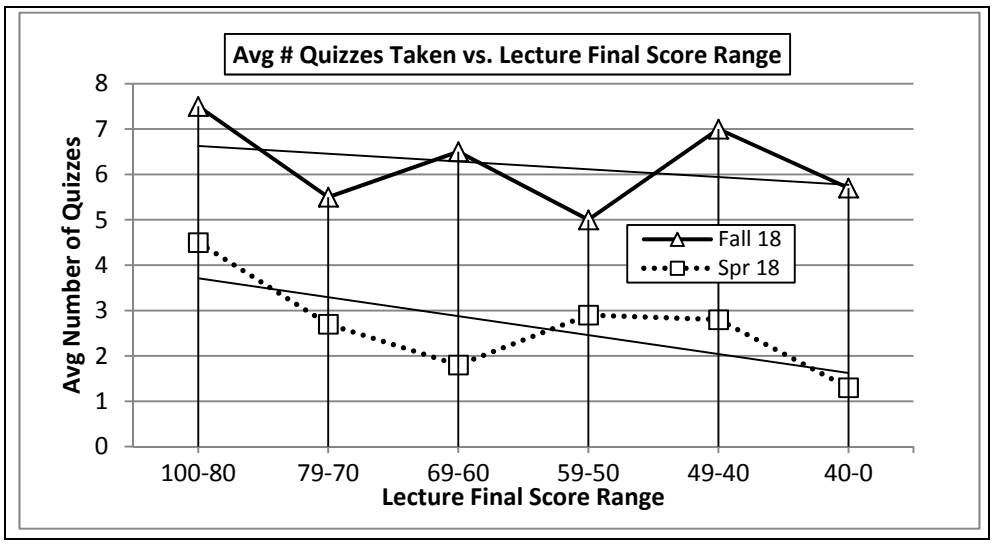

Figure 8: Average number of quizzes taken as a function of lecture final score.

We asked two questions on the lab final regarding our FAST approach. Answering the questions represented 4% of the exam; all students wrote something and received full credit. The first question asked how the quiz option affected their overall performance in the course. We considered students stating the quiz option did nothing or not directly stating anything to be neutral, students stating "I think" the quiz option helped or hindered as a weak response, and students stating the option helped or hindered as a strong response. We show weak and strong responses in Table 4 with lower and uppercase lettering, respectively.

Table 4 shows that overall 62.7% of students felt the quiz option helped, while 89.6% of students reported that the quiz option did not hinder their performance. Overall, 10.4% of students reported that the quiz option hindered their performance. Table 4 also shows that 83.4% of fall quarter students felt the quiz option helped as compared to 50% of the spring quarter students.

Question 1): Did having the quiz option *help*, *do nothing*, or *hinder* your performance in the course?						
Quarter	**HINDER**	**hinder**	**neutral**	**Help**	**HELP**	**# studs**
Spr_18	2.1%	10.4%	37.5%	37.5%	12.5%	48
Fall_18	3.3%	3.3%	10.0%	30.0%	53.4%	30
Totals	2.7%	7.7%	26.9%	34.5%	28.2%	78

Table 4: Responses for Question 1.

We also asked students what determined whether they took a quiz or not; we divided their responses into a few common themes. Table 6 shows the percentage of students in both quarters who indicated a particular reason; some responses indicated multiple reasons while other responses provided no useful information. A significantly higher number of spring students indicated external course load as an issue compared to fall students. The average number of units taken by students in these courses for the spring and fall quarters was 15.8 and 15.2 units, respectively.

Question 2): What was the main factor determining whether you took a quiz?		
Responses	**Spr_18**	**Fall_18**
if student felt prepared	56.3%	60.0%
external course load	29.2%	13.3%
labs due or not	8.3%	16.7%
past quiz performance	18.6%	6.6%
if student showed up or not	2.1%	3.3%
fear of assessment	2.1%	3.3%
lessen final weight	2.1%	6.6%

Table 5: Representative responses for Question 2.

Part of Question 1 asked students to be specific as to why they felt the quiz option helped or hindered their performance. Table 6 lists representative responses for every student response; a significant number of students provided no response or no meaningful response. Table 6 represents responses from students reporting the quiz option did not hurt their performance, while Table 7 shows the representative responses from students reporting that the quiz option hindered their performance.

Representative responses to the question of why or why not take a quiz for students who reported the quiz as being helped or neutral		
Response	**Spr_18**	**Fall_18**
motivation to keep current	7.1%	25.0%
provided study material and/or exam-type problems	16.7%	17.9%
provided gauge of knowledge/progress	11.9%	21.4%
lessened weight of final	2.4%	7.1%
lessened stress	7.1%	10.7%
gave time to ask questions	0%	7.1%
supported self-paced learning	4.8%	7.1%

Table 6: Representative responses for Question 1.

Representative responses for students reporting that quiz option hindered their performance		
Reasons	**Spr_18**	**Fall_18**
wanted to be forced to study	16.7%	50.0%
wanted gauge of progress	50.0%	50.0%
issues with exams/quizzes	16.7%	0%
self-reported “lazy”	16.7%	0%

Table 7: Representative responses as to why quiz option hindered students.

Conclusion

This experiment provided students flexibility in assessment by giving them the option to take any number of weekly quizzes; not taking a quiz resulted in transferring the weighting of that quiz to the course finals. We ran this experiment over two quarters for a total of three sections of an introductory digital design course taught in a studio classroom using a flipped classroom format.

We found that the higher performing students (based on cumulative GPAs) tended to take the most quizzes, which believe we is responsible for our data showing a correlation between the number of quizzes taken and the final course grade. A majority of students (62.7%) reported the quiz option as helping their performance and 89.6% of students reported the quiz option did not hinder their performance. Although many students reported that the quiz option helped motivate

them, provide them with example problems, and helped them gauge their progress, students generally opted to take less quizzes as the quarter progressed. Having access to previous quiz problems seemed to increase student confidence and possibly inspired students stay current with course material. Additionally, the quiz scores provide feedback to instructors regarding individual student performance while requiring only a minimal amount of extra instructor effort.

The experiment had some unexpected results. First, we conducted the experiment in the spring and fall quarters. Fall quarter students took over twice as many quizzes as the spring quarter students, despite the course load between the two quarters only differing by 0.6 units. We attribute this result to general academic burnout in the spring quarter. Second, the spring quarter was primarily computer engineering students while the fall quarter was primarily electrical engineering students; fall quarter final grades were 9.1% higher than the spring quarter including a significantly higher number of A grades. This result was particularly surprising as we generally expect better performance from computer engineering students based on the significant HDL aspect of the course. Third, students in the fall quarter had access to quizzes and solutions from the spring quarter, which may have served to influence their quiz taking decision and overall course grade. Repeating this experiment should shed light on these results.

Assessment research differs from traditional research as it is intended to inform and improve one's own practice rather than make broad generalizations. Additionally, we strive to keep the benefits of assessment in proportion to the time and resources we devote to them[10]. In short, our results indicate higher performing students used flexible assessment in a positive manner, while other students used the flexibility as a way to fall behind in the course without immediate consequences. While our results are primarily qualitative, we consider it an improvement in the teaching process and it thus inspires us to continue making such improvements, with an added emphasis on helping students who do not use flexible assessment in a positive manner.

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