Quarantining High-Stakes Assessments in an Introductory Physics Class

By Richard L Pearson III and Chad Rohrbacher

In March of 2020, every course at Embry-Riddle Aeronautical University's Daytona Beach (ERAU-DB) residential campus made the pivot to online learning. The vast majority of the face-to-face courses became virtually synchronous where most faculty scrambled to record lectures and looked at alternative ways to assess student learning. Simply put, it was a challenging and chaotic time. The faculty team overseeing the introductory physics courses, however, used that chaotic situation as an opportunity to holistically re-imagine the course assessments in order to better engage the students in a new learning modality.

The calculus-based, introductory Newtonian mechanics physics course is foundational across many STEM disciplines. At ERAU-DB, nearly a thousand students take the course every year: in the 2020 Spring term, over 300 students were enrolled. The small class size (approximately 40 students) requires a concerted effort to deliver a consistently rigorous presentation of materials by a group of 6-8 full-time faculty. In typical face-to-face (F2F) environments, faculty present content in a blend of traditional (e.g., lecture slides, chalkboard derivations and problem-solving) and active-learning methodologies (e.g., peer instruction, group problem solving, guided-inquiry tutorials). See Meltzer and Thornton (2012) for resources on other physics-specific, research-based, active-learning instruction. Before March, assessment of learning in this introductory physics course was fairly traditional, comprising of mostly high-stakes unit (or midterm) exams with a comprehensive final.

When campus closed to F2F lessons in Spring 2020, the physics faculty discussed the course and, using input from the Associate Director of the Center for Teaching and Learning Excellence, made alterations. Seventy-five percent of the course's summative assessments had not been completed at the time of the pivot, and assessments became the focus of the course revisions. A few goals guided the discussions. First, any adjustments needed to maintain the course's goal of building conceptual understanding within problem-solving methodologies; in other words, the student's ability to problem solve and think critically to solve physics problems is of much greater importance than simply identifying the "correct answer." Second, the faculty wanted to remove high-stakes tests that were to be administered in the new online environment to help students cope with the pandemic interruption and minimize cheating.

The final decisions were ultimately based on cognitive science literature. The class content was envisioned in smaller, more manageable "chunks." The unique—and difficult—nature of introductory physics is that many of these "chunks," or learning blocks, are strongly associated with one another. However, to magnify this method of manageability, the high-stakes unit exams were reconstituted into bi-weekly assignments that carried less weight (i.e. low-stakes). As Roediger (2013) noted, students learn and recall information better with frequent opportunities to recall and apply the new knowledge. This is enhanced when the practice is distributed across time and across tasks. The faculty believed this new class architecture would help students focus on the importance of the learning process and encourage more routine practice.

In the original F2F model, high-stakes exams contributed 85% to the student's grade; tests were given in person and proctored. The new online modality required faculty to think creatively about ensuring student engagement and reliable assessment of learning. In the new model, a comprehensive final exam was retained at 20%, while the remaining exams were diffused across twelve assessments: six low-stakes (about 6.5% each) and six lower-stakes (about 2.5% each) assessments. Thus, the more frequent lower-stakes assessments removed a major motivator for cheating, as no one high-stakes assessment was going to "break" their ability to perform reasonably well in the class. It also gave students plenty of opportunities to focus on the day-to-day learning rather than on trying to cram for tests. Both assessments consisted of a variety of conceptual multiple choice and short computation questions conducted through the learning management system. Each contained equivalent material, but the first included a scaffolded problem designed to prepare the students for the second of the two assessments, which included a longer, handwritten question graded by the faculty (as would have been administered in the former, higher-stakes unit exams).

In the end, students reported being more engaged with the course but overwhelmed with the bi-weekly assessment arrangement. While the physics faculty team successfully reached their goals of developing student conceptual and problem-solving skills while removing high-stakes assessments, it continues to seek the right balance between optimal student workload and student learning.

As ERAU enters Fall 2020, the physics team is teaching in a number of modalities including F2F, hybrid, and online. The newly implemented, overall class architecture of learning blocks remains intact, as it is flexible for any of the teaching modalities. Similarly, the lower-stakes, weekly assessments provide a focused, summative evaluation of each block. A structured, long-problem (hand-written to show steps) homework assignment is used as preparatory work for the low-stake, monthly assessments. In the spirit of continuous improvement, faculty are providing a voluntary Likert-style student survey after each block that asks students to reflect on statements such as “The activities in this module guided my learning” and “I felt the module assessment tested my knowledge of the module concepts fairly.” The goal is to get real-time feedback concerning student learning, as well as identify potential opportunities to improve the block structure in future semesters.

What started off as a reactionary process to an interruption of teaching became an opportunity to create lasting change. And just as the most effective preventative measures to the current virus outbreak are straightforward (such as wearing a mask and washing hands), the faculty team for ERAU’s introductory physics course believes the focused routines of low-stakes assessments will continue to be more effective and more meaningful for both students and faculty, regardless of teaching modality.

References

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