Remote Exams:
Recommendations and Best Practices

CEAS Remote Exam Working Group

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July 2020

**1. Introduction**

The Remote Exam Working Group was created as part of the academic implementation team formed by the College of Engineering and Applied Science to help the college with implementing CU’s [Road Map for Fall 2020](https://www.colorado.edu/roadmap/). The working group met six times in June and July 2020 and engaged in a broad discussion of issues related to technology, pedagogy, and student success. This report presents our findings in several sections as follows: (1) the working group’s main recommendations, (2) issues related to health and wellness that drive a number of recommendations related to pedagogical concerns, such as suggestions on how to structure both courses and exams, (3) an overview of the four main technologies that CU provides to create, deploy, proctor, and/or grade remote exams, followed by some reflections on these technologies by various members of the working group, and (4) a discussion of pedagogical concerns that can be useful when designing exams. The report sometimes repeats recommendations; we view this repetition as a good thing. A short bibliography at the end presents papers that the committee reviewed, which may prove useful to the wider CEAS community after reading this report.

**1.1. Context**

* We teach courses to “Gen Z” students in the context of a national mental health crisis in higher education and significant political upheaval in the US alongside a global pandemic that is seeing a surge in cases in the US. It is thus important to recognize that faculty, students, and staff are under significant stress.
	+ With respect to exams, students under extraordinary stress suffer impairments that affect memory, general cognition, and decision making, which are all important when taking tests. The on-line exam environment may increase those stresses.
* As such, faculty must revisit the design of their courses and their associated assessment strategies—which includes exams—to take this context into account (McMurty, 2020). Indeed, just the mental health crisis alone would be sufficient reason for this redesign; when combined with the other factors, the need for this redesign is even more pressing.

**1.2 Recommendations**

* Redesign courses to have simpler structures and more flexibility for students; document course structures, learning goals, and course policies clearly in the syllabus; and adopt a range of assessment strategies that move away from the use of high stakes exams (where performance on one or two exams are the primary determinant of a student’s final grade).
	+ Exams can still be used for assessment but should be integrated alongside low-stakes/high-frequency testing, such as weekly quizzes and multiple, focused homework assignments that allow students to demonstrate deeper conceptual understanding and mastery of techniques.
	+ Test problem-solving abilities and deeper understanding of subject material using projects, presentations, and oral examinations (see, e.g., the “seven-minute exam” discussed in Section 3.8) rather than drawn-out application/derivation questions on midterm and final exams.
	+ Give longer projects or take-home exams, instead of timed exams; this can reduce stress and help accommodate home environment and internet issues.
	+ Adopt the use of oral or recorded oral homework/quizzes; this provides the opportunity for assessment with less cheating and gives students practice explaining concepts.
	+ Please note that not all of these assessment strategies can be used for all classes; however, faculty should be aware of a wide range of assessment strategies and make use of them to help move their course away from traditional structures that place too much emphasis on high-stakes, timed exams.
* Redesign exams to be shorter and more focused; understand and make use of best practices associated with question types (Piontek, 2008); ensure exams can be realistically completed in the time allotted and the questions on the exam are recognizable to students who have been engaged in the course; have clear rubrics for all questions; and support exams with flexible course policies to reduce test anxiety (such as dropping the lowest exam score when computing the overall final grade in a class; students still need to prepare for and take each exam but such a policy can help to reduce their stress if they struggled early in a course or a major life event disrupted their ability to prepare adequately for an exam later in the semester).
* Make significant use of the Canvas learning management system; take time to learn its features and [follow standard practices when creating your Canvas course](https://www.colorado.edu/engineering/goingthedistance); and make use of Canvas quizzes along with its integrations with tools that can help manage remote exams, such as Gradescope.
* While the campus offers access to Proctorio, the remote exam working group does not recommend its use because of privacy concerns and reports from students that they feel that its use indicates to them that their instructor does not trust them not to cheat; instead, the remote working group recommends making use of video proctoring via Zoom in combination with other technologies, such as Canvas and Gradescope, to address potential issues of academic dishonesty without the use of overly invasive technologies, e.g., Proctorio. This recommendation is especially important given the mental health crisis mentioned above.
* In contrast, the remote exam working group endorses the use of Canvas, Zoom, and Gradescope for managing remote exams; these tools provide a lot of flexibility, and the tight integration between Canvas and Gradescope can greatly reduce the work associated with the grading of assessments.
* When designing remote exams, adopt policies that can address the extra work and challenges that students can encounter during the exam.
	+ Avoid the need to be on-line for the entire exam since some students may live in environments where access to the internet is unreliable; students may be disconnected multiple times during the exam through no fault of their own.
		- Provide a means by which students can contact you or a TA during the exam to report on loss of internet access issues to ensure back-up plans can be devised and implemented.
	+ Distinguish between time allocated to taking the test from time that is used to deal with the delivery mode; students may need extra time to print a remote exam; or to take screenshots and upload their work for the exam.
	+ Try to avoid choices in the deployment of remote exams that prevent students from making use of standard test-taking techniques; for instance, many students like to review an entire exam before they start working on problems, so that they can make decisions on how they want to invest their time, which problems they want to solve first, etc. (This recommendation does not apply universally; for instance, configuring Canvas quizzes to give problems in a random order, one at a time, is a standard technique to help reduce the temptation to collaborate—this style of assessment works well for testing simple, conceptual problems on an exam). Allow the use of some combination of notes, worksheets, and textbook during an exam to reduce the pressure on memorization and reduce the need for systems like Proctorio.
	+ Be sure to make use of the same technologies that will be used on a remote exam in your class on a low-stakes assessment that occurs *before* the exam; this will allow students a chance to practice everything they need to use for the exam in a low-stress setting.
	+ Decide early if you are going to require all students to take the exam at the same time; if so, communicate this decision to your students early in the semester to get their feedback and concerns; some students may live in significantly different time zones and thus may be required to take the exam at an odd time (e.g., 3 AM); by seeking feedback, the instructor will boost student engagement and identify potential problems that can then be accounted for before the exam. Be sure to publish an exam schedule with all dates and times in your syllabus at the beginning of the semester and ask students to contact you early to make arrangements if they cannot make the published times.
* Academic dishonesty is an important issue and raises significant challenges in the context of remote exams; experience from Spring 2020 indicates that students will engage in behaviors that were considered cheating, based on the policies and expectations set by the instructor. Some contributing factors include the “commercialization of cheating” via sites like Chegg and Coursehero (despite these sites often having [honor codes](https://www.chegg.com/honorcode)), the difficulties students encounter with keeping up with a class delivered via on-line modalities, and the perception that the chance of being caught and the consequences for getting caught are low. The remote exam working group recommends adopting techniques that reduce a student’s need to cheat to address this issue vs. making use of overly invasive technology, such as Proctorio, to combat cheating.
	+ Recognize that students need more scaffolding and more support in on-line settings and adopt strategies to help students keep up with the course material.
	+ Address the culture of cheating head on; lead a discussion about it in lecture and get students to reflect on the harm that they do to themselves in the long term via cheating.
		- One member of the remote exam working group shared that students who cheated (by consulting with friends in the class) during a spring 2020 exam did more poorly on the exam (compared to their classmates and compared to their own performance on an earlier exam). This example can be used to convey to students that cheating does not necessarily lead to better performance.
	+ Provide opportunities in your course to do reflection on both the course material and your discussion of cheating; this provides students with the opportunity to understand the full range of consequences related to cheating and helps students understand the value of the course material.
	+ Use such conversations and reflections to build trust and adopt policies and techniques to reduce the need for cheating
		- avoid the use of high-stakes exams
		- make use of Zoom to perform low-stakes proctoring
		- set clear expectations at the start of the semester the consequences for violating the [Honor Code](https://www.colorado.edu/sccr/honor-code-faculty-and-staff) and have that information clearly explained in the syllabus as well
		- make use of [reflection](http://cpree.uw.edu/) both during an exam and throughout the semester to have students understand the importance of what it is they are learning and why they should master it
		- over time, develop large question banks for exams so that multiple exams can be deployed at the same time to reduce the chance that students are working on exactly the same exam; this can work both in automated testing environments like quizzes in Canvas as well as with exams deployed using Gradescope
		- set clear expectations ahead of the exam on the types of collaboration (if any) or the types of scaffolding (open book, open notes, etc.) that students are allowed to use during the exam
		- discourage cheating by placing a CU copyright watermark over each question on an exam as this will prevent sites like Chegg from storing and posting a copy of the exam questions and answers
* Some faculty may want to avoid the use of remote exams altogether in AY 20-21 and instead try to provide in-person exams; while not impossible, there will be significant challenges due to the situation we find ourselves in this year because of COVID-19. Two primary challenges are 1) not having access to rooms large enough to allow all students in a section to take the test at the same time and 2) not having all students available to come to campus for an in-person exam; some students may have all of their classes on-line and, as such, may not be living in Colorado during the academic year. Nevertheless, for students in Colorado, it may be feasible to have all or a portion of an exam in-person, using multiple rooms and perhaps two successive sessions with half of the class in each session (and making allowances for remote exams for those students fully remote).
* Consider not grading on a curve (norm-referenced grading); instead let students know that their grades will be based on how well they learn the material (criterion-referenced grading) rather than how well they score relative to other students (Piontek, 2008). Removing the competitive aspect of assessment will reduce stress and the sense that cheating gives an unfair advantage in grades.

**2. Mental Health**

It is important for faculty to understand that the US is in the middle of a mental health crisis with respect to undergraduate students who are part of Generation Z (born 1995-2010); 25% of teens these days meet the criteria for an anxiety disorder, and mental illness is the second most common reason for students dropping out of school.

CU is not excluded from this crisis. In the past three academic years, CU has consistently seen an increase in student utilization of Counseling and Psychiatric Services (CAPS). For the 2019-20 academic year, CAPS had 56,378 total student encounters through individual therapy, group therapy, psychiatry appointments and walk-ins.

Gen Z students face intensified expectations facing early and persistent pressure to academically excel, fit in socially, and be successful after graduation; they likely have been raised with a parenting style that is highly involved and creates busy, overscheduled, failure-averse students who struggle to adapt to challenges as they arise in college; they also have matured in a rapidly evolving political climate that exacerbates student issues with stress, anxiety, and depression. An increasing percentage of students navigate substance abuse issues, looking to use drugs and alcohol to relax while also using prescription drugs to focus and work late into the night. Finally, increased time on social media can amplify existing stressors and contribute to a sense of social isolation on campus.

In Spring 2019, CU Boulder assessed students regarding their health and wellness. A few findings are noted below:

* 92% of CU students reported feeling overwhelmed by all they had to do
* 69% reported feeling lonely
* 66% experienced overwhelming anxiety

These students reported the following factors as impacting their academics: stress, sleep problems, cold and flu, anxiety, depression, work, internet use, family concerns, relationships, and alcohol use.

CU has responded by expanding mental health and wellness services to increase support, but the growth in demand outstrips CU’s ability to grow the capacity of these services in a managed way.

This information provides context for other recommendations made in this document. Faculty cannot design courses and exams by thinking about the way things were when they were students; *the student population today is significantly different.* Faculty can still have high expectations for their students, but courses need to be designed to achieve learning goals while providing flexibility and simplicity to accommodate the challenges students face from the mental health crisis.

Now, with the global pandemic and recent political unrest, the challenges that faculty and students face have grown with no underlying change to the mental health crisis described above. The pedagogical recommendations made in this report are designed to help both faculty and students deal with these challenging times.

**2.1 Course Structure and Design**

One key recommendation given the context of the mental health crisis, the current political climate, and the global pandemic is to spend some time examining the structure of a course with an eye towards making it simpler and easier to understand. Courses should have a clear set of learning objectives and have a set of material and assessments designed to enable a student to gain skills and knowledge that meet the objectives. Balancing the need for simplicity is a recommendation by the engineering education research literature to reduce the use of high stakes exams in a course. What makes an exam high stakes is when the final grade of a student rests on their performance on just one or two exams (e.g., a single midterm and a single final). Research has shown that such course structures cause students to cram for the test and then forget most of what they have learned after the exam. Therefore, the literature recommends providing students with more assessments that are lower stakes (such as weekly quizzes or multiple sets of homework) with proper scaffolding of the material, such that exams, when they occur alongside the other assessments, are *valid* (actually tests students knowledge of the concepts under discussion), *reliable* (consistently measure different levels of student achievement), *recognizable* (instruction has prepared students for the assessment), and *realistic* (students can reasonably complete the assessment in the time allotted)  [Piontek, 2008]. It is okay to continue to offer exams, but they should be true opportunities for assessing the learning outcomes of the students and not a barrier that has such high stakes that the anxiety associated with just taking the exam impacts student performance.

A second key recommendation is to design your course policies to maximize flexibility for the students to further reduce stress and to allow students to navigate complex situations that may arise for them that span several courses. Common techniques include providing the ability to drop their lowest homework and/or exam score; incorporating mastery-based learning techniques into the structure of the course; providing a reasonable policy for the grading of late work, and adopting assessment techniques that are straightforward to grade (such as automatically graded assessments within the learning management system).

**2.2 Exam Structure and Design**

Hand in hand with designing courses with simplicity and flexibility in mind is applying the same principles when designing an exam. As mentioned above, it is still okay to make use of exams (and indeed recommended as a way to assess in depth comprehension of a course’s concepts and techniques) as long as they are not the only means of assessment. If the exam is just one assessment among many, the stress around taking the exam goes down for students and gives all students a fair shot at success.

Within an individual exam, the learning objectives being assessed should be clear, and the appropriate type of assessment for each concept should be used. For instance, a multiple choice question should not be used to solve a technique that requires multiple steps. A mistake made in an early step will cause the student to miss the question and provide no opportunity for the instructor to provide partial credit.

In designing the exam for the current context, a key recommendation is to shorten the exam while still ensuring that all concepts are being tested with enough information to assess whether learning objectives are being met. A shorter exam ensures that overly stressed students are able to complete it and not have their anxiety compounded by having to submit an exam with many problems incomplete. Short exams also reduce the work on the team that is grading the exam.

**3. Technology Overview**

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| --- | --- | --- |
| Technology | Pros | Cons |
| **Canvas**: Learning management system with many features that can be used to deliver assessments. | Flexible support for a range of assessments with features designed to reduce the burden of grading; Well supported by CU with documentation and training videos | Non-trivial learning curve for instructors new to learning management systems |
| **Gradescope**: A flexible software system for grading a wide variety of assessments. | Allows students to work on printed exams or scratch paper and then scan their handwritten work for upload into Gradescope; Gradescope then significantly automates the grading process and provides support for having teams of instructors and TAs grade a single exam; Great integration with Canvas including with its Gradebook | Small learning curve; not directly supported by OIT, but has [great training resources on-line](https://www.gradescope.com/get_started) |
| **Zoom**: A video conferencing system that can be used to proctor remote exams | Both faculty and students have experience with zoom; it is straightforward to use zoom to proctor a remote exam | If used for proctoring, Zoom does not have the same features as a dedicated proctoring solution, such as Proctorio, and not all students have access to cameras (even better is to require they use their phone camera and Zoom, so that they cannot text classmates during the exam) |
| **Proctorio**: An automated exam proctoring system | A wide range of options customize what students are allowed to do while taking a test; machine learning is used to monitor all students during the test, greatly reducing the need for human proctors | The system is considered invasive by many as it gets access to a student’s browser and camera, and might require students to take pictures of their test taking environment (i.e., their home). Students have shared that the use of Proctorio by an instructor makes them feel that the instructor does not trust them. It currently works only with the Chrome web browser. |

**3.1 Canvas**

[Canvas](https://oit.colorado.edu/services/teaching-learning-applications/canvas) is CU Boulder’s official learning management system; it provides many features for supporting the delivery of a course including announcements, modules, discussion forums, and more. Additional information about Canvas is available at its [official website](https://www.instructure.com/canvas/) and at CU’s dedicated [support page for Canvas](https://oit.colorado.edu/services/teaching-learning-applications/canvas/help).

Within the context of remote exams, the Quizzes tool in Canvas can be used to administer assessments in a quiz format. The quizzes tool has several questions types, including Multiple Choice, Matching, Numerica, Formula, and Essay. Most of the question types can be auto-graded. Instructors can control when a quiz is available and how much time students have to complete a quiz, as well as which results are released to students and when they are released. Quizzes make it easy to adjust the exam availability window, time limit, and the number of attempts for individual students (e.g., if a student needs to take an exam at a different time or needs extra time to complete it). Canvas Quizzes also integrate with Proctorio, the proctoring software supported at CU Boulder.

Instructors can [get support with setting up their exams in Canvas from OIT’s Learning Technology Consultants](https://oit.colorado.edu/services/consulting-professional-services/learning-technology-consultants/consultation-request). OIT also offers [training sessions on Administering Quizzes in Canvas,](https://oit.colorado.edu/services/consulting-professional-services/learning-technology-consultants/academic-technology-trainings) both as live session and as [on-demand recordings](https://oit.colorado.edu/services/consulting-professional-services/learning-technology-consultants/academic-technology-trainings#ondemand). Finally, the Canvas Community Course available from the CEAS [Going the Distance](https://www.colorado.edu/engineering/goingthedistance) page, provides an example of creating and configuring quizzes in Canvas.

**3.2 Gradescope**

[Gradescope](https://www.gradescope.com/) is a web service that supports the grading of assessments in courses including homeworks, quizzes, exams, and more. Gradescope can be integrated into Canvas and provides support for a team of instructors and TAs to grade assessments allowing for rubrics to be developed on the fly and changed after the fact (for instance, if you decide that a certain mistake should only deduct two points and not five, you can update the rubric, and the change will be applied to all exams automatically). Gradescope provides maximum flexibility since it works with PDF documents; is well integrated into Canvas’s gradebook; and it even has features that allow for the automatic grading of coding assignments. Below, we feature how some of the working group’s members have used Gradescope (and Canvas) to successfully deliver remote exams in Spring 2020 and share lessons learned from that experience.

Gradescope is available to all instructors in the College of Engineering and Applied Science. It is not a campus-wide supported tool. To enable Gradescope integration in CEAS courses in Canvas, locate Gradescope in the hidden Navigation links in the course settings and [add it to your course Navigation menu](https://community.canvaslms.com/docs/DOC-12933-how-do-i-manage-course-navigation-links). When you click on the Gradescope link for the first time after adding it to your navigation menu, you will be prompted to set up your course with Gradescope. After that has occurred, your roster and grades can easily be synced between your account on Gradescope and your Canvas course.

**3.3 Proctorio**

[Proctorio](https://oit.colorado.edu/services/teaching-learning-applications/proctorio) is an automated exam proctoring system available at CU Boulder. It is integrated with the Quizzes tool in Canvas and operates as a browser extension. More information about Proctorio is available at its [official website](https://proctorio.com), and CU provides a [variety of support materials](https://oit.colorado.edu/services/teaching-learning-applications/proctorio) for learning and using Proctorio for both faculty and staff.

Proctorio uses machine learning and facial detection technology to remotely proctor exams to help discourage academic dishonesty. It scans a student’s ID and face to verify the student’s identity and captures a student's video, screen, and other actions during an exam to identify suspicious behaviors. Instructors can customize which student actions they would like to monitor for each exam (e.g., to allow using scratch paper or not). Proctorio flags suspicions behaviors for optional review by instructors. While there are benefits to using Proctorio as we teach and learn remotely, it is important to consider whether Proctorio is appropriate to use for your exam.

**3.4 Zoom**

[Zoom](https://zoom.us/) is CU’s supported video conferencing system, which was used extensively both before, during, and after CU’s transition to remote instruction in Spring 2020. Its capabilities should be well known by most CU employees. Within the context of remote exams, instructors have been using it as a straightforward way to proctor exams. The basic idea is that a Zoom session is started for the exam and all students connect to that session. They leave their video cameras on and then take the exam as normal. An instructor or a TA may split students up into different breakout rooms (instructors share that for large classes, a common breakout room size is 24 students, which makes it easy for a proctor to see all students in a breakout room at once) and then monitor students during the exams for any behavior that might indicate they are acting outside the expectations set by the instructor for academic honesty. A standard practice is for a TA to create a spreadsheet to take notes about the behavior of students in their breakout room. Once students have been assigned to breakout rooms, a link to the exam can be shared to all students via Zoom’s chat feature. Given that Zoom can be downloaded as an app on mobile devices, if a student is having problems with internet access, they may still be able to join the Zoom session during an exam vai the cellular connection of their smartphones.

This approach to proctoring also allows for students to ask the instructor or a TA a question about the exam and for the instructor to broadcast the answer to any frequently asked questions about the exam to all students, recreating an aspect of in-person exams that might otherwise be lost in a remote setting. Note: a standard practice for this aspect of Zoom proctoring is to configure Zoom’s settings to only allow chat with the proctor of the exam (and not student to student).

**3.5 Reflections on the Use of Canvas**

With respect to the use of Canvas and Gradescope, one member of the remote exam working group shares that he made use of Canvas Quizzes to create simple on-line questions, which he used for short quizzes, a portion of a midterm, or final exam, and as a way to get rapid feedback from students during a lecture (as an alternative to clickers). He primarily used this functionality in Spring 2020 for three types of questions:

1. Multiple-choice questions: He found multiple-choice questions best for qualitative concepts and simple (one-step) quantitative questions. He does not use this type of question for multi-step quantitative questions since the student then has no room for error or partial credit. He made use of Canvas features, such as having Canvas randomly select questions for each student from a large question bank. He also had Canvas present the questions one at a time, with an answer required before the student could view the next question. These two features help to address academic dishonesty concerns. Another plus associated with using this type of question is that they are automatically graded by Canvas.
2. Short-answer questions: He found written questions for which students could easily type their answers in Canvas (ones that did not require long equations or drawings) are also very effective. These questions are then graded by the instructor or teaching assistant directly in Canvas using its Speedgrader functionality. Combined scores from all questions are then automatically uploaded to the Canvas gradebook.
3. Long-form questions: He also made use of longer questions that required written answers with equations, derivations, and/or drawings. In these cases, the questions were written in Canvas but students would write their solutions on paper and then scan and upload the solutions to Gradescope. Students were comfortable doing this during an exam because that is how they would submit all of their homeworks for the class.

**3.6 Reflections on the Use of Gradescope**

Gradescope is an effective grading tool that can be used to administer remote exams, in-person exams, and homework assignments and aid in their grading. Assignments can be submitted by the instructor, students, or student groups. The tool allows for a rubric to be created dynamically while grading based either on a positive or negative point scale. Changes made to a rubric are applied to all submissions for a given assignment.

For the remote part of the Spring 2020 semester, one of the remote exam working group members administered exams that were scheduled for the entire class at a specified time. At the start of the exam, she would email a pdf to each student (with the exception of students in different time zones who were taking the exam later). The students would then work on their own scratch paper (or printed exam, if they preferred) and upload a pdf of their scanned work. She gave students fifteen additional minutes to allow time for them to scan their work and upload their submissions. Once time had expired, Gradescope was configured to no longer accept submissions (although an alternative is to allow late submissions, as Gradescope records the submission time). If students had technical difficulties, she asked them to email their work directly. When submitting, students “train” Gradescope where to find the answers to each question. Gradscope then automatically breaks down each exam submission by problem # to streamline the grading process.

**3.7 Reflections on Remote Proctoring**

Regardless of the remote proctoring strategy that is adopted for a course, a few standard recommendations have emerged from the working group’s conversations. Some browsers work better with the technologies listed above; make sure to test your exam set-up on a variety of platforms or convey to students which browsers have been tested (on which operating systems). At the start of the test, leave time for students to check-in with their proctor by showing their BuffOne card to confirm their identity. Have clear start and stop times but provide options to deal with problems, such as being able to submit their work via Canvas or e-mail. Some instructors have allowed students additional time to provide better quality images for their solutions after the exam has ended; some students may generate low-quality images by mistake or because they ran out of time and were not able to afford the time it would take to upload high quality images. Finally, plan ahead to deal with issues of academic dishonesty by having multiple versions of an exam or by making exams a low stakes experience if students will be taking an exam at different times.

**3.8 Incorporating Presentations Into the Remote Modality**

The remote exam working group learned about the “[7-Minute Exam](https://canvas.vu.nl/courses/47759/pages/oral-exam?module_item_id=375564)” as a technique for conducting oral exams in a remote teaching modality. With this proctoring method, students are asked to prepare a 7-minute presentation on a topic related to the course. After the presentation, the student answers questions posed by their instructor. The total examination time should not exceed thirty minutes per student. Each session is recorded for review in case of grade disputes after the fact.

Grades for the exam are determined on the spot—possibly in consultation with a TA or another instructor—following a simple grading scheme (0, 1, or 2 points per question). Arguments in support of using this method state that it positively influences a student's understanding of the material and they demonstrate that understanding by being challenged in real-time to answer questions about the underlying material as well as their presentation. The total time taken to implement this type of assessment needs to be compared with the time to prepare, write solutions, proctor, and grade a traditional exam before it is discounted out-of-hand. While it may not scale to CEAS’s largest classes, it may take less time to administer and grade than exams in medium and small classes.

**4. Additional Pedagogical Concerns**

**4.1 Reducing stress to improve student performance on tests.**

Many of our students will be under extraordinary stresses this semester (financial, health, family, etc.), which affect memory, general cognition, and decision making, all important in taking tests. The on-line exam environment may increase those stresses.

**Recommendations:**

1. Allow use of some combination of notes, worksheets, textbooks, etc. during the test to reduce the need to rely on memorization.
2. Use low-stakes/high-frequency testing through the semester, which can easily be done in Canvas quiz modules for multiple choice questions and those requiring single-step calculations for numeric answers. Students may not have to receive grades for all of these; in that case, these questions play a role similar to clicker questions. Having a larger number of short quizzes through the semester could reduce the incentive for academic dishonesty as well.
3. Give students agency by including the opportunity to give feedback on questions during the test asking for ratings on relevance to class material and whether the question was realistic within the time frame of the test. This type of feedback can be collected in Canvas using an ungraded question configured with a Likert scale answer.
4. Students may lose access to wi-fi during a test if not on campus. Have means of notification and a backup plan.
5. Consider using methods other than in-class tests to assess student learning of higher-order material and critical thinking, such as small projects. A downside is that grading is more time consuming.
6. Keep Zoom video streams active during a timed on-line test.

**4.2 Promoting Learning in Testing**

Having the opportunity to correct an error during a test can aid learning in real time and can be done in Canvas, for multiple choice, matching, word, or numeric answers.

**Recommendations:**

1. Configure Canvas quiz to allow students a chance to see an incorrect answer and go back to submit a new one. If you do this for multiple choice questions, consider adding an extra answer or two to reduce the effectiveness of pure guessing.
2. Use practice tests with questions from old exams or other sources (such as the Fundamentals of Engineering exam). If these example tests are timed using Canvas, students get a chance to practice test-taking strategies while preparing for their exam.

**4.3 Multiple choice questions**

Multiple choice questions work well in on-line tests on Canvas and are easy to grade. They can be good for assessing student understanding of basic concepts and simple calculations to solve problems. In general, they are not considered good for problems requiring more complex reasoning or critical thinking. Writing plausible answer choices can be time consuming, although once done, they are easy to grade; Canvas does this immediately, which gives students feedback quickly. However, students may tend to guess, which defeats the purpose of assessment; as such, it may require several iterations to get the right balance of options to achieve proper assessment.

**Recommendations (Piontek, 2008):**

1. Write the problem statement—called the “stem”—clearly.
2. Keep both the stem and the answer choices as brief as possible
3. Do not put extraneous information in the stem
4. Minimize the chance that students will misread the question by avoiding the use of negatives that they might miss.
5. Have only one correct answer and at least three incorrect answers. Avoid answers like A and C, all of the above, or none of the above.
6. Have the same number of words and detail in all the answer choices.
7. The wrong answers should be both plausible and clearly wrong compared to the correct answer
8. Avoid *all of the above* and *none of the above* answers. Typical instructions are to choose the best answer and these options can confuse students.
9. In Canvas, select the option to scramble the answer options for students so that they are randomly distributed.

**References**

Major, J. C., & Scheidt, M., & Godwin, A., & Berger, E. J., & Chen, J. (2020, June), *Effects of Test Anxiety on Engineering Students’ STEM Success* Paper presented at 2020 ASEE Virtual Annual Conference. <<https://peer.asee.org/34511>>.

McMurty, Beth. (2020). “What does Trauma-Informed Teaching Look Like?”. The Chronicle of Higher Education. <<https://www.chronicle.com/article/What-Does-Trauma-Informed/248917>>.

Parsons, David. (2008). “Is there an alternative to Exams?—Examination Stress in Engineering Courses”. International Journal of Engineering Education, 24(6), pp. 1111-1118.

Piontek, Mary. (2008). “Best Practices for Designing and Grading Exams”. CRLT Occasional Papers, No. 24. Center for Research on Learning and Teaching. University of Michigan.

Supiano, Beckie. (2020). “Can a Different Approach to Testing Help Students Remember What They Learn?”. The Chronicle of Higher Education. <<https://www.chronicle.com/newsletter/teaching/2020-01-09>>.