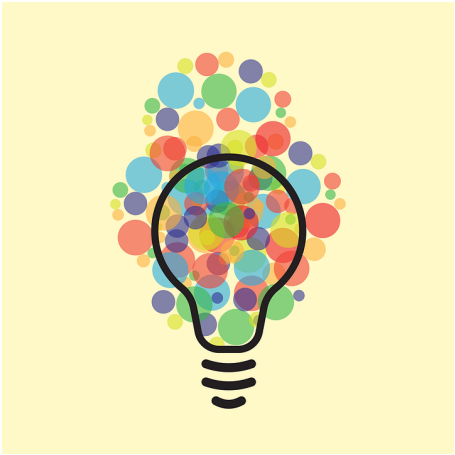

Report of the MIT Ad hoc Committee on

Leveraging Best Practices from Remote Teaching for On-Campus Education

8.9.2022

The Committee

Members

Sheryl Barnes
Steven Barrett (spring semester)
Brian Canavan
Wes Esser
Steve Hall (fall semester)
Shannon Johnson
Ken Kamrin
Katrina LaCurts
Adam Martin
Anne McCants
David McGee
Shigeru Miyagawa (fall semester)
Meghan Perdue
Krishna Rajagopal (co-chair)
Janet Rankin (co-chair)
Mike Short
Mark Silis
Larry Vale
Rodrigo Verdi (spring semester)
Kate Weishaar
Mary Ellen Wiltrout
Ezra Zuckerman (fall semester)

Administrative Support

Dan Nocivelli (TLL)

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I. Introduction: Charge and Work of the Committee

When the pandemic tsunami crashed down upon all of us in March 2020, all across MIT people dropped what they were doing and worked incredibly hard, together, to do whatever was needed. Some focused on research continuity. Others supported our students. Others built a remarkable testing and contact tracing infrastructure. A small core group of people drawn from the Teaching + Learning Lab, the Office of the Vice Chancellor, MIT IS&T, Sloan Technology Services and the Digital Learning in Residential Education team from Open Learning focused on the pivot to remote learning. The frontline work, however, was done by faculty, instructors, members of the Digital Learning Lab, and TAs in every department across MIT. How we teach at MIT varies enormously from department to department and typically even varies significantly within any one department. Every faculty member, and everyone who contributes to teaching, had to figure out new ways of helping our students to learn when they, and we, were remote. The mantra of the small core group throughout was "What is your plan? How can we help?" We began in March 2020, and then over the subsequent year, with support and continuous improvements, educators across MIT built the plane as it was in flight.

This is history now, a history that none of us wants ever to relive.

The question that our committee has been asked, though, is what have we learned? Even though the experience of remote teaching and learning was as challenging and exhausting as one can possibly imagine, for teachers and students alike, with adverse consequences for everyone including mental health setbacks and significant lost learning opportunities whose cascading consequences continue, there were seeds planted then that, we hope, will bear fruit in the coming years. Our committee is charged with looking at how these seeds are germinating, how they can be nurtured, and how they may grow as time progresses.

The Ad Hoc Committee on Leveraging Best Practices from Remote Teaching for On-Campus Education has grown from a recommendation of Task Force 2021, specifically a recommendation from RIC16: Undergraduate and Graduate Living and Learning, which in turn owes much to work of the Education Group from the first phase of the Task Force.

In the long run, one of the best things about having lived through our remote learning experience may be the intense, and broad, focus on pedagogy that it necessitated. In a moment when nobody could just teach the way they had always done before, all of us ***had to*** go back to first principles and ask ourselves: What are our learning goals for our students? How can we best help them to achieve these goals? During the 2020-2021 academic year, to a much greater degree than any of us has experienced in our decades at MIT, everybody was thinking about ***how*** to teach. This was happening at the level of individual faculty and instructional staff, course teams including TAs, small groups of colleagues in myriad random conversations, regular meetings convened by many departments, and in the 8am Covid calls that more than a hundred people from across the distributed leadership of MIT participated in. A particularly impressive example comes from Sloan which hosted approximately 40 zoom town halls for faculty and instructional staff

between March 2020 and December 2021 with agendas that ranged from short-term information sharing (campus policies, sources of pedagogical innovation and support, logistical and health updates, etc.) to sharing best practices to longer-term opportunities for pedagogical advances. At the MIT-wide scale, there has surely been no other time when all the deans, vice presidents, department heads, lab directors, leaders of key units, chairs and members of key committees spent hours (in sum) over several months listening to vignettes from individual faculty about how they were teaching, what was working, and what was challenging, and then discussing them intensely in Zoom chat and with raised Zoom hands. For everybody involved in teaching at MIT, this was a positive aspect of how we navigated the pandemic. We are hopeful that the energy and attention that was focused by so many people on how best to teach will pay dividends in the longer term.

Our charge is more specific, though. What are the things that we learned how to do during the pandemic that faculty and instructors across MIT are now, already, building into their on-campus teaching? Our committee has asked this question broadly across MIT. We reached out to all departments, with each member of our committee assigned to engage with a few. We spoke with people like Associate Department Heads or (under)graduate officers who are likely aware of what many colleagues in their own department are doing and thinking as well as engaging in conversations with individual instructors. We asked what modifications/adjustments people or departments had made in their teaching and learning practices this academic year when we are all back on campus, based on what they had observed and learned during the pandemic. We asked about what people had done during the pandemic that had prompted them to make changes now, and what impacts they were seeing on student learning. We also asked everyone we spoke with what they were hearing or seeing their colleagues doing that was going well, and what curricular and pedagogical changes they wished to make going forward, based upon experiences during the pandemic. Finally, we asked what resources or supports would help them achieve those goals. This report is a distillation of the more than one hundred answers we received via the conversations that individual members of our committee had along these lines, across MIT.

It is worth noting that we focused on reaching out to instructors, including faculty and instructional staff, in departments across MIT but we did not reach out, directly, to TAs or to students. It is also worth noting that a majority of the instructors with whom we spoke told us about changes that they had made to how they teach their undergraduate classes, which are often larger than graduate classes and are (in many but not all departments) perceived as having priority. That said, we have good reasons to believe that many-to-most of the themes and practices highlighted in the report are relevant to, applicable to, and being applied in, graduate subjects being taught at MIT, including by the same instructors whom we spoke with. Our report is synthesized from what we learned from many dozens of conversations across all of MIT, but there is much more that can be done in future to assess the impact of developments in the directions that we have identified. We hope that the Committee on the Undergraduate Program and the Committee on Graduate Programs, including in particular their student members, in partnership with the Teaching + Learning Lab will more thoroughly investigate some of the practices and themes identified in this report and more rigorously assess their impacts on learning at MIT.

The charge to our committee was framed by the work of RIC16 from Task Force 2021. In their report, they wrote:

> *"So much of the magic of MIT lies in the unscripted engagement that happens among our community members, whether it be students working together on projects and problems or students and instructors engaging in seminars, labs, UROPs, … As we all return to campus this coming academic year, the digital delivery modes with which we now have become familiar can be deployed to deliver some of the scripted parts of our teaching; how do we take advantage of this experience to create more time and space for the interactive, engaging, components from which the magic originates? … The creativity and ingenuity brought out over the past year by the necessity of finding ways to engage with students and support group interactions, thinking anew about what works and why when we could not just teach the way we always have, are sure to bear fruit in the long term. Surely, we will be able to use what we have learned to create more engagement, more magic, when we are all bumping into each other again."*

RIC16 sought answers to the following questions:

- What lessons can we learn from our collective experience [in 2020] that will help us find ways to fulfill our educational mission even more effectively [going forward]? How will doing so impact campus?
- In each disciplinary context, how do we save more in-person time for the kind of intense engagement (between student and instructor, and among students) that yields moments of understanding or discovery or creation?
- What precursors to those experiences can be learned well when taught online?
- Can we fulfill our institutional mission even more effectively if we take technology-enabled modes of teaching and learning increasingly seriously?

Much, but not all, that we heard via our consultations across MIT fit within this framing. Indeed, we heard about a focus on blended learning. (In some cases this can be referred to as flipping the classroom, but the notion of blending the use of online learning modalities into the learning experience of our on-campus students in ways that allow us to create more engagement when we are together is more general.) Indeed, we heard myriad ways of improving and deepening engagement among students and between students and faculty. Some of these involve delivering some of the scripted parts of our teaching online; but many more do not. A further variation on this theme that we heard from many directions is the use of video conferencing (e.g. via Zoom), which became much more familiar during the pandemic, to add authentic engagement between our students and experts in a certain domain, located far from our campus, as part of the on-campus MIT educational experience. Replacing the in-person interaction, discussion and engagement that happens in classrooms, labs, hallways and lounges on campus by Zoom cost us much of the magic of MIT and is happily behind us, but at the same time we learned that interaction by Zoom with colleagues, experts and alumni across the continent or around the globe is a worthwhile addition. We aim to describe the essence of all the different variations on these themes that we heard from what people across all of MIT are doing.

A further thread, consistent with what we were asked to listen for but perhaps not explicit in our charge, is ways in which people have learned how to use new tools so as to increase the efficiency and efficacy with which we do what we were already doing previously. An example is the use of Gradescope, which is now in use in many different departments but which we do not think was being used at MIT at all before the pandemic. It is being used in ways that make grading problem sets and tests more efficient and which yields more consistent and informative feedback to our students.

There was one crucial theme, present in what we heard from many departments and many individuals, that was not anticipated in our charge. We heard from across MIT about new ways to help our students build community, maintain wellbeing and develop a sense of belonging. Maintaining each of these became exceptionally challenging during the pandemic, in particular when we were all remote. When faced with this challenge faculty, departments, and administration devoted energy and attention to how to help our students address these critical aspects of their education. Many of the approaches that were pioneered in the face of adversity are being continued because they will be of value going forward. Examples include new flexibility with deadlines, new ways in which instructors are beginning their classes with wellbeing and community in mind, and the new mentoring program for first and second year students that the physics department has introduced. Although this may not have been reflected in our charge, *a posteriori* it is easy to imagine that these developments may turn out to be the most important ones in this report in the long run. After all, wellbeing and belonging are a foundational prerequisite to learning, and the vibrancy of the MIT community is a necessary precursor for all of the magic in an MIT education.

The spirit of this report is principally our committee sharing what we heard from people across MIT that they are already doing. It may be too early to use the phrase “best practices”, but **we are seeking to share many excellent practices that MIT instructors are following in the hope that people in their own departments and sections can learn from what those in all the other corners of MIT are doing. Our principal recommendation, to instructors across MIT, is simply that they should read this report with this goal in mind.**

We describe our findings in two ways, in Sections II and III. In Section II we group them into themes, in this way connecting different practices that we heard described and making our best attempt as of mid-2022 to put them into context. In Section III we provided brief, annotated, stand-alone descriptions of each individual practice, in the hope that these descriptions will be of value as a reference to instructors in the months and years to come. Along the way, we identify (and flag in bold-faced type) a few recommendations that go beyond the principal one stated in the paragraph above; we collect such recommendations at the end of the report, in Section IV; and in Section V, we offer some brief, final thoughts on the adaption and adoption of these practices.

II. Themes and Findings

In this Section, we describe our findings grouped into themes. A focus on strengthening our community and the wellbeing and sense of belonging of its members may be the most important theme that we heard — so we shall begin with it in the next subsection. Furthermore, this theme was woven in with so much that we heard that at various points in subsequent subsections we have further highlighted community or wellbeing or belonging as appropriate. The next subsections focus on themes of enhancing engagement among students and between students and instructors, enriching and augmenting the learning environment, and assessing learning.

II.A. Community, Well-being and Belonging

Community, well-being and belonging are interrelated concepts that play key roles in student academic success, overall health, and in essentially all aspects of our students' experience. The centrality of community and of individual well-being is familiar to all. A sense of belonging in some ways underlies both, as it affects not only student mental health directly, but also how often and in what ways they seek help for issues at MIT, both academic and personal. Thus cultivating a sense of belonging to multiple communities within MIT, especially after the pandemic stressed so many of them so severely, is paramount to a high quality student experience. Belonging, individual well-being, and the strength of the overlapping communities that make up MIT are crucial for our students to thrive, not just survive, academically and in life, at MIT and when they spread their wings beyond MIT.

As the members of our committee listened, we heard from across MIT about new ways to help our students with community, well-being and belonging that had developed, under stress, during the pandemic, that people saw as adding value for the future, and were planning to maintain. The shutdown of the campus in March 2020 with its associated shift to remote learning significantly negatively impacted the standard, pre-pandemic, environments and strategies that were in place that supported student belonging and well-being and that created and nurtured our communities. These were undercut by isolation, limited opportunities for informal interactions around subject material and with peers and instructors, and barriers to help seeking. In response, MIT faculty and instructors found that they had to work differently, consciously, and much harder, to build classroom communities that supported students' sense of belonging and contributed to their well-being. What we heard as a committee, over and over again, was that efforts with these characteristics begun during the pandemic were "keepers" that should and would be continued into the future and sustained.

Most of the examples we heard are woven into later sections of this report as this theme is interwoven with those that follow. After all, a community in which people (students and everyone) feel a sense of belonging and a sense of focus on wellbeing, their own and that of others, is a necessary precursor to all aspects of our educational mission. And, this goes both ways. Classroom practices that help students feel that they are an integral part of the class, that their ideas matter, and that their perspectives are welcomed, create a sense of

academic belonging. Often, strategies that create inclusive classrooms and inclusive departmental environments support students' sense of belonging. Additionally, classes that utilize more structured active, interactive, and collaborative classroom practices can also foster academic belonging and promote a sense of community by facilitating student-student and student-instructor interactions and engagement. In this way, the theme of belonging, well-being and community gets interwoven with much that follows, and indeed serves as a part of the motivation for many of the practices we describe in later sections.

In the remainder of this section, we highlight four examples that can stand alone.

II.A.1: Extended Thanksgiving Break

In Fall 2020, classes did not meet during Thanksgiving week. This was designed to allow many students time to leave campus and return to homes or travel elsewhere, in advance of an ending to that semester that was conducted entirely remotely. These reasons for the one week break are not to be repeated, but we heard from many informants that a one week break over Thanksgiving was a ***very good*** new feature of the Fall 2020 calendar that ***should*** be perpetuated because it serves the wellbeing of students and instructors alike. In our standard Fall calendar, the Thursday and Friday of that week are official holidays and little teaching or learning happens on the Wednesday. Giving up two teaching days (the Monday and Tuesday) to create a full week break would give everyone a chance to recharge before the final weeks of the semester. Everyone needs a break by that point in the semester (if not sooner!) and if we had a full Thanksgiving-week defined as such then the times that students are away would synchronize, rather than conflicting as they do now with everyone making their own time for travel. Although we recognize that our committee was not charged with developing a detailed implementation plan for a recommendation like this, our discussions took us at least part way down this path. **We recommend that the appropriate faculty committees (CAP, CUP and CGP) and the Registrar's office charge an implementation group with doing a full investigation of how best to introduce a one week break over Thanksgiving in MIT's academic calendar.**

II.A.2: Physics Mentoring Program

Recognizing that the shift to remote learning would present many challenges to students, and in particular and of most concern to our most vulnerable students, the Physics Department (led initially by Ed Bertschinger and Kerstin Perez) introduced a one-on-one mentoring program for 8.02 students who struggled on the first midterm, hoping to improve the self-efficacy and STEM identity of these students, which is to say their wellbeing and sense of belonging. The Physics Department judged the program to be such a success that it has continued and expanded it, now offering one-on-one mentoring to students from across MIT in all versions of 8.01 and 8.02 as well as to students in 8.03, 8.04 and 8.044. The mentees are students enrolled in these subjects; the mentors are more senior undergraduates or graduate students knowledgeable about the physics content and prepared to offer academic and social support. The objectives of the program include providing course-based academic support to undergraduate students but they go well beyond this. Goals include building mentor-mentee relationships as a means to connect mentees to institutional resources, building community within the department, and

establishing a community of practice in which the student mentors are partners with faculty and staff in the (academic) mission of the department. For training, the mentors participate in a practice workshop where they watch four brief mentor/mentee skits and discuss them with each other and then roleplay in groups such that each has a chance to play the mentor, mentee and observer. Mentors also review sample mentoring compacts, which are agreements between mentors and mentees to set expectations and goals for both and for their relationship. During the semester, mentors have weekly Zoom meetings to share experiences and learn from each other. This provided equal footing for all mentors regardless of whether they were faculty, staff, or students. This even had the added benefit of boosting undergraduate mentors' sense of STEM identity and community, as they were able to work on a professional level with physics faculty and staff. This program represents a significant additional effort by many in the department; the fact that it has been continued and expanded signifies its value.

II.A.3: Extensions and Flexibility

Our third example is almost a meta-example. We heard from many directions that some of the changes made during the pandemic were motivated as much or more by empathy than by pedagogy. The typical example, of which we heard many variations, was giving students more flexibility – and agency – with deadlines, along the lines of allowing them to choose to turn in some number of their assignments some number of days late without penalty.The exact nature of the extension can vary depending on the class, but the key is that students know these extensions will be granted and can choose if/when to apply them. What we heard from instructors was that changes like this, motivated by empathy, were improvements that they hoped would perpetuate and become even more common.

II.A.4: Start-of-Class Welcoming Practices

As a fourth example, we highlight that many instructors have introduced new ways of beginning their classes with wellbeing and community in mind. Some are asking their students to introduce themselves at the beginning of the semester with a slide or a one-minute video, allowing them to be creative in choosing and explaining images with metaphorical or personal significance. Others are beginning every class session with music playing as people gather – in some but not all cases choosing music that in some way reflects the subject. Yet others are now choosing to begin some or all class sessions with check-ins, spending 5 minutes or so asking how students are doing. These are not new practices, but they are more common now than they were pre-pandemic. Creating a space and time where students can share their struggles and joys contributes to their wellbeing and belonging. And, students who feel safe and supported are likely to engage in more creative problem-solving and discussion.

II.B Enhancing Engagement

Our charge notes that the magic of MIT begins with engagement. Engagement between students and instructors. And engagement among students. It is therefore gratifying that from all across the MIT community we heard examples of new ways in which people are enhancing both. In addition, we heard examples in which instructors have found new means to enhance the engagement among instructors!

II.B.1 Engagement Between Students and Instructors

Improving Office Hours

Of necessity, instructors moved their office hours online during fully remote teaching. In doing so, they discovered that this has benefits as well as costs. Though many students and instructors derive greater value from meeting in person, others prefer virtual office hours as they reduce many of the physical, emotional, or time barriers to participating in in-person office hours. Meeting via Zoom also makes practices such as screen sharing to collaboratively review a document easier, although meeting in person (with a blackboard, a whiteboard, or a yellow pad) remains preferable to most when it comes to creative problem-solving.

Many instructors across MIT have concluded that it is best to offer a mix of Zoom and in-person office hours, combining the convenience, low activation barrier for attendance, and less intimidating nature of online office hours that brings in many students, including some who would not have participated otherwise, with the wider, more varied, and potentially richer and more valuable engagement options available for students who attend in-person. In-person office hours have the potential for the kind of engagement between a small number of students and an instructor that creates memories that last for years; this is less likely on Zoom. But, our collective experience beginning during the pandemic is that many more students participate in Zoom office hours, to their benefit.

Furthemore, Zoom office hours can be set up so as to allow students who join to “stay afterwards” and keep working together. This facilitates their learning and improves engagement among students, especially if it includes shy students who may not already have found pset groups to work with. We are also hearing about new variants of office hours, renamed in ways that bring students in. For example, in some biology classes there are now “problem set parties” where groups of students ask questions of instructors and faculty.

Undergraduate TAs

Several departments substantially increased their use of undergraduate TAs during the pandemic, and plan to continue. We heard from the Math department, for example, that the best consequence of doing so was involving undergrad TAs in recitations. In the past, math recitations were typically ~ 1:20 -- one grad TA and 20 students. By adding undergrad TAs, the discussion portions of recitation became much smaller groups, ~ 1:4 or 1:5 at most, and the discussions became much better, much more interactive. The experience in 8.01 and 8.02 reported by the Physics department was similar, although in that case this was an expansion of a decade-old practice. Note that this can be seen both as improving the engagement among undergraduates and as improving the engagement between undergraduates and their instructors – since the undergrad TAs are both. We also heard that the teaching experience of the undergrad TAs was a positive element of their own MIT education.

Journaling

Instructors can ask students to write short journal entries (~300 words), either as graded assignments or as informal check-ins. In the former case, if aligned with the topic, journaling can be used as a form of weekly homework or as one of several options for a graded assignment. Journaling can be less stressful than other assignment types; student wellbeing is one motivation of some instructors who have introduced this as an element in their classes. In the latter case, if journaling is not relevant to the class material it can be offered as a method for sharing feedback with the instructor or as a way for students to share how they are doing, allowing instructors to get to know their students better and recognize when they may be struggling. In either case, journaling can offer students a much-needed time for reflection – whether about class materials, their MIT experience, or life in general.

II.B.2 Engagement Among Students

Many of the examples above are just as much about enhancing the engagement among students as they are about enhancing their engagement with instructors. Here we add a few more examples with a particular focus on student-student engagement.

For some students, the Zoom space made it possible for them to be more 'authentically' themselves. If they are shy, not confident about their spoken English, or intimidated for some reason in/by the physical classroom, they could contribute soundlessly to classroom discussions via the Zoom chat function. This opened up class discussion for some students who had otherwise not participated. This suggests that we should push further to understand what aspects of the Zoom world made those kinds of learners more willing to speak up so that we could postulate ways to extend such wider participation in the post-Zoom in-person classroom environment.

Some of this seemingly has to do with the capacity for students to both see each other's faces more directly and to hear their words more clearly (since in Zoom land even the most soft-spoken students had microphones in their devices). In the absence of an on-screen component such as Zoom, one implication of these observations is that the arrangement of seating in classrooms matters. Classrooms that are larger than a single seminar table could be designed to mimic that advantage, such that students face not only the instructor (and any projected material) but also are oriented so that they can more easily see each other. This implies classroom orientations that are more semi-circular, with fewer rows, rather than rooms that are oblong and deep.

This is one illustration of the need for a standing Classroom Advisory Board that brings pedagogical goals to the forefront as MIT plans investments in its classrooms over time. As discussed further below, where additional motivations arise, we support and amplify this recommendation of RIC 16 from TaskForce 2021.

From the math department we heard an example that is in a sense quite different but that is also motivated by improving the engagement among all students, including those who are shy. The math department has introduced a home-grown tool to help students in large

classes form pset groups. Students register themselves in a database (overseen by Andrew Sutherland and the MIT Mathematics Department) and each week the system attempts to match the students with those that have compatible schedules and preferences for collaborating or studying together. This was first introduced during remote teaching but the math department sees it as just as important now as then. This tool is now being used in more than one department; links to the active site and sandbox version are available here, https://psetpartners-test.mit.edu/about , and an article describing it can be found here: https://www.ams.org/journals/notices/202111/rnoti-p1919.pdf . Instructors of large classes with weekly problem sets can check this out and if they decide to use it they can add a link and brief instructions to their syllabi and Canvas sites.

Pset groups are just one among many forms of out-of-class engagement. We heard examples from various directions of ways in which, building upon experiences that began during remote learning, many classes are now much more deliberate about creating out-of-class communication spaces where students can share ideas and questions. In some classes, this corresponds simply to greater use of Piazza Q&A which has been in use for years. Other classes used tools like Slack, Perusall, and Discord which have become common more recently in ways that emphasize different styles and goals of discussion. These practices can build community by extending in-class engagement to other times of the week and can give students a method for formulating their questions, discussing them, and finding answers. In some cases, these practices now serve as a graded activity (either as formative assessment or a piece of students' participation grades). However, instructors should take care to not overwhelm students with digital tools and should ensure that discussion is clearly structured so students understand how and when to engage. Integrating such tools into a subject's Canvas page, and including clear guidance there on expectations for their use, is helpful.

II.B.3 Engagement Among Instructors

Interestingly, we also heard of classes where the use of an asynchronous communication space like Slack by the team of faculty, grad TAs, and undergrad TAs teaching a subject enhanced the sense of community of the teaching team, and created more cohesion. Some noted the enhanced motivation and contribution of the TAs. Others even noted examples where exemplary ideas and suggestions shared with the whole teaching team by undergrad TAs raised the game of the more senior members of the team.

II.C Enriching and Augmenting the Learning Environment

To some degree, the way that we have separated our findings among themes is artificial; the boundaries between themes are blurred. Indeed, our first big and multifaceted example of enriching and augmenting the learning environment — blended learning — is at the same time all about enhancing engagement within our community in our classrooms. And, our second example, increasing the authenticity of our students' learning environment which is again big and multifaceted, could also be phrased as enhancing the engagement with the larger world in our classrooms. As we shall see, both these examples also point in the direction of one of our central recommendations.

II.C.1 Blended Learning

Many instructors at MIT have been using a mix of synchronous activities during scheduled class time in-person and asynchronous activities that students access online. As indicated in the Introduction, the key to this instructional strategy, often called blended learning, is to ask how best to use the in-person time in ways that create the kinds of engagement and active learning experiences that need students and instructors to be together, and from which the magic of MIT can emerge. Effective blended learning models will be different in different disciplines and for students at different levels. There is more commonality, though, to the kinds of asynchronous online activities that work well and in particular these need not only involve video. Instead, MIT instructors typically find better student engagement in the classroom if the in-person teaching is preceded by sequences or combinations of short videos, interactive online activities that the student does rather than watches, computer-graded problems, or reflection questions that support learning, all done as a part of the subject units designated for outside-of-class work. The pattern of regular digital assignments, both pre- and post-class, increases course structure, which improves student performance.[1] Adopting blended learning also promotes spaced learning as students first learn concepts asynchronously and subsequently enhance and begin to apply their understanding via interactive synchronous sessions and active learning techniques. Blended learning techniques have been developed over the past decade in many departments and contexts across MIT. These efforts got a boost during the pandemic as more faculty saw the value of blending well-designed asynchronous activities with synchronous teaching.

Lab classes in both chemistry and physics are developing video-based, and other materials for pre-lab work. These are lab-class variants of blended learning. From chemistry we heard that students watch videos of how to set up and run an experiment before coming to the lab, that this has been well received by students and instructors, and that it improves the in-lab experience by helping students to visualize what they will need to do in advance, and reduces stress and anxiety. The videos may have been available before the pandemic – indeed some were shared with the world on OCW – but their use as an effective means of pre-lab preparation for our students was prompted by the ways (other aspects of which are not to be repeated) in which chemistry lab classes navigated remote teaching. And, indeed, most of the videos being used in this way were created recently by chemistry TAs. In 9.12, Experimental Molecular Neurobiology, TAs made videos of the key experiments and experimental techniques in the days before they went home in March 2020 and these (and other such) videos are being used today in much the same way as in chemistry. Subsequently, the instructors in 9.17, Systems Neuroscience, have begun augmenting the experience of their students by live streaming an experiment that was more complex than could be performed in the teaching lab. In physics (Junior Lab; 8.13 and 8.14) there may be some video resources along the lines of those used in the chemistry labs, but the Junior Lab team has focused much more on sequences of video segments with auto-graded

[1]Freeman S, Haak D, Wenderoth MP. Increased course structure improves performance in introductory biology. *CBE Life Sci Educ*. 2011 Summer;10(2):175-86. doi: 10.1187/cbe.10-08-0105. PMID: 21633066; PMCID: PMC3105924.

exercises interspersed that teach methods of data analysis, error estimation, and such. Teaching these during the in-lab sessions never worked well; the online sequences are better received. Furthermore, they are then available to the students later, when the students have data to analyze and need to use these techniques. By helping the students to achieve these learning goals asynchronously, outside the lab, the Junior Lab team has made more in-lab time for the actual labs themselves, for learning by doing, and for learning via engaging with the instructors.

In a different twist, we heard that some classes [6.302, 6.115, and 6.131 (new numbers 6.3100, 6.2060 and 6.2220), 8.02, 16.06, 20.309, 21H.343/CC.120 (mini-printing-press kits), 22.01 (DIY Geiger Counters), and MAS.863J are examples] are continuing to use take-home lab kits developed during the pandemic. As above with the goal of optimizing the use of in-person lab time, these subjects have identified elements of their lab activities that students can meaningfully complete from their dorm rooms.

For twenty years, 8.01 and 8.02 have focused on making the in-class time an active learning experience, with students learning by doing – in this case doing physics problems in groups of three with undergrad TAs circulating, teaching by asking questions and discussing. The challenge has long been how best to help MIT first-year undergraduate students to prepare well, on their own time, before class. During the pandemic, the 8.01 and 8.02 instruction teams addressed this by deploying sequences of video segments alternating with autograded online problems designed to be done on your own, many but not all of which were originally developed for online MITx versions of these subjects. During the pandemic they emphasized these asynchronous learning sequences to such an extent that they reduced the number of hours of synchronous (synchronous by Zoom during remote teaching) instruction from five hours per week to three. The 8.01 and 8.02 teams are continuing with this approach, as they find that this prepares MIT students well and creates a better, more engaging, more active, in-class learning experience. However, starting in Fall 2022 they are tweaking the balance, moving to four hours per week of synchronous in-person instruction. For course teams like this that had prior experience with blended learning, the pandemic tilted the balance between asynchronous and synchronous instruction and they are now tweaking that balance anew. They also report that the pandemic prompted them to better optimize their asynchronous learning sequences – they said that these materials are now, finally, really well structured and organized and that the present suite of materials has significantly helped both students and instructors this most recent year. We also heard from them and from others that undergrad TAs were a key part of how they navigated the pandemic, and the increased use of undergrad TAs in ways that reduce the number of students whom each TA engages with and improve that engagement is key to their planning for the future.

2.001 is an example of a subject whose blended-learning transformation (analogous in spirit to that described above) had already been successfully completed over the decade preceding the pandemic. Its instructors found that their blended learning tools were enormously helpful as they navigated the pandemic, with the changes they needed to make being only the introduction of more extensive (zoom) office hours and of projects in lieu of exams. The first of these has continued, with extensive office hours (26 hours per

week in total) now offered some-by-zoom and some-in-person. The 2.001 team has returned to traditional exams post-pandemic. The central pedagogical structure of the course, based upon extensive use of blended learning tools that make an engaged classroom experience possible, is the same after the pandemic as it was before. Course 2 sees it as a testament to the blended learning approach developed by its instructors that 2.001 was so successful during the pandemic, a success that has been noticed by others planning other subjects.

The story in many Course 6 subjects is somewhat similar to that in 2.001. Online, asynchronous, delivery of some fraction of the material is a natural fit for the many EECS subjects which have over many years: built the necessary online infrastructure, in some cases including collaborative asynchronous editing tools and online games; de-emphasized traditional lectures; and focused in-person, synchronous, time on active learning and hardware- or software-based labs. As in 2.001, this prior investment in blended learning certainly made the transition to remote learning in Spring 2020 easier, albeit with the addition of extensive virtual office hours. These subjects in Course 6 consistently rely upon intense, and extensive, in-class interactions between instructors and students and among small groups of students. This high level of interaction and engagement was quite difficult to maintain during remote instruction; learning was compromised, and magic was lost. In many of these subjects, the return to campus has brought a renewed emphasis on, and enthusiasm for, the synchronous and in-person elements of the educational experience from instructors and students alike as well as a clear-eyed evaluation of the optimal balance between these elements and the asynchronous online elements, to ensure that the latter serve to support and enhance the former as intended.

The examples of blended learning discussed above are all from undergraduate classes, but faculty are also exploring variants of blended learning in graduate subjects. One example that we heard about was 8.711, the introduction to nuclear and high energy particle physics intended for first year physics PhD students. Inspired by what he learned during the pandemic, the faculty member teaching this subject has turned his in-class sessions into discussions in which he and his students review, probe and discuss material that they first see in pre-class videos that he has made. As a side remark, this example highlights the reason why these developments are largely occurring in science and engineering subjects: they are quite unnecessary in 10-20 student SHASS classes where the in-class learning experience has been based upon discussion and engagement since forever.

Much of what we heard about an increased focus on blended learning so as to create more active in-class experiences points toward the importance of investing in our classrooms in ways that support the pedagogical goals for the kinds of active learning experiences and engagement that we are seeking to create in them. RIC16 from Task Force 2021 recommended the creation of a standing Classroom Advisory Board composed of faculty, staff with key responsibilities, and students to spearhead strategic planning for classroom spaces that flows from the evolution of modes of pedagogy, learning and teaching in different disciplinary contexts across MIT. We strongly endorse this recommendation, as we shall discuss further below.

Nobody was planning for a pandemic, for a near-empty campus, for remote teaching. Nobody. But, it turns out that the investments that many people across MIT had made in digital learning over the past decade were, without knowing it, building resilience. Now that we're all back on campus, we can let memories of our time apart fade, and return to creating the magic of MIT together. A part of how we'll support doing that will be by blending online learning experiences that work well as such into the on-campus education of our students.

II.C.2 Increasing Authenticity

We have heard from many directions that during the pandemic faculty found that they were able to increase the authenticity of the learning experience of their students by bringing experts whom they knew, from anywhere in the world, into the classroom via Zoom, and that they plan to continue doing this into the future. Though some instructors brought experts to their classes via video-conferencing tools prior to the pandemic, it was not a common practice. Instructors typically chose to assign the students readings that the expert had written or to send students to engage with that person in IAP or the summer. These practices of course remain, but the first does not yield engagement and the second is not an option for most students in your class. Bringing an outside speaker from far away into the MIT classroom for, say, an hour in-person discussion made no sense. Now, though, we all understand that this is easy to do via Zoom. The engagement that our students can have with such an expert via Zoom is much more than is possible by reading their writings, although of course it is a lesser experience than going to visit. Still, enabling every student in a class to meet and interact with an expert from anywhere via Zoom is a clear win, a clear increase in the authenticity of the learning experience that connects our students to the world outside MIT in a way that an instructor curates and integrates into their subject. This can serve to introduce, motivate, or complement the experiential learning opportunities that students may take advantage of during IAP or summer.

We heard many examples of practices along these lines, which are clearly here to stay.

In one MIT Sloan class about finance and biotech, the instructor incorporated multiple panels of outside experts in vibrant online discussions that included student participation and that over the course of the semester added up to bringing about 30 outside experts into the classroom via video conferencing.

During the Fall 2020 and 2021 semesters, the Department of Biology offered a 2-unit, first-year discovery course, 7.00 COVID-19, SARS-CoV-2 and the Pandemic, organized by Richard Young and Facundo Batista. Through private Zoom sessions, MIT students had the chance to get the latest scientific updates from world experts on viruses like Anthony Fauci or our own Bruce Walker and ask their own questions. Kizzmekia Corbett discussed her work on the mRNA vaccines just days before Moderna released the very successful preliminary clinical trial results in November 2020. Students had recitation discussions with a teaching assistant about the relevant background to prepare for an upcoming speaker or to learn more about the experiments in the lab with the help of a current researcher. In addition to international public access to a live stream of the class session, the recorded

versions were made freely available through the Biology Department's website and YouTube a few days later to help the world hear more from trusted sources, and the MIT OpenCourseWare website points OCW learners to this website, maintaining its impact for the long term.

A somewhat different example arises nowadays in language classes: students are going on virtual field trips to meet with people in the country whose language they are learning. Virtual field trips are also a part of some classes in DUSP and Architecture, with an instructor using Zoom and Google Maps to do virtual neighborhood interpretive walks with an elderly co-instructor, for example one based in Philadelphia. Such engagement entailed a fuller, multi-sensory, real-time immersion in another place, thereby enhancing the authenticity and immediacy of the student experience.

Students can also benefit by interacting with students from other universities who are engaged in the same topics that they are learning about. For instance, faculty in the History department have created partnerships with faculty at universities around the world and ask the students to each complete the same set of readings, and then participate in Zoom discussion sessions outside of class without faculty supervision to unpack the readings, followed by short written reflections about how the conversation went. This is particularly impactful when the student groups bring diverse experiences and insights to the material, and can learn from each other in an informal, but supported environment. Faculty have reported that these cross-university Zoom reading discussions have gone really well, and the students enjoyed meeting peers around the world and hearing their thoughts on the material.

In yet another variation on the theme of enhancing authenticity, Terrascope used Zoom to facilitate engagement between their students and experts from whom they can learn more about what they are researching but also between their students and alumni mentors who joined not to make presentations themselves but to first watch students present status updates for their projects, and then give feedback from the big screen at the front of the class. We also heard of other examples where experts were brought in to give feedback on presentations and even one case where an entire middle school class was invited to attend a presentation by Zoom and ask questions. The gain in authenticity can thus come via MIT students receiving more authentic feedback on their work.

We are impressed with how many examples along the above lines we have heard, and with the number of different variations on this theme that have emerged in the two years since many of us Zoomed for the first time. We are confident that these modes of increasing the authenticity of the education of MIT's on-campus students by allowing them to engage with the world from within our classrooms will grow and further evolve.

Among all the examples we have heard, though, perhaps the most impressive initiative comes from Anthropology Professor Amah Edoh, who teaches a class on Reparations for Slavery and Colonization. She brought experts, typically activists, from Algeria, Burundi, Congo and Rwanda into her classroom in a way that goes beyond only doing that. She recorded the lectures that these guests gave, and shared the video recordings with the

world on the OCW YouTube channel almost at the same time that they were being watched by her MIT students. Then, via the OCW YouTube channel she gathered questions and comments about the lectures that came in from people all around the world. Since the guest speakers spread the word about this opportunity within their circles, the questions and comments that were received included input from others in Algeria, Burundi, Congo and Rwanda. Then Prof. Edoh led classroom discussions at MIT that the guest speakers joined via Zoom, and these discussions between the students and guest speakers were informed by the questions and comments from others around the world, prompted by the presentations given by the guest speakers. This example, as far as we know unique to date, goes well above and beyond the (much more common) practice of "just" bringing guest speakers in via Zoom.

Hearing about all these tremendous new ways of increasing the authenticity of what we offer our students by bringing others into our classrooms by Zoom provides a second strong motivation for investing in technology improvements in classrooms across MIT. The work of our committee provides a strong pointer in this direction, but not a roadmap. We have not done a sufficiently systematic survey of this new aspect of the learning goals that MIT instructors have for their students to attempt to answer the question of how many, and which, MIT classrooms should be kitted out with Zoom technology at what level of quality.

A third example is automated video recording of classroom activities, most often desired for lectures. The desirability of this is the subject of much discussion and considerable ambivalence. We heard from some whose first consideration is that the video recordings are a resource for students who have to miss class or who are studying for a test. We heard serious concerns from others that students who use these recordings as a crutch, instead of attending in person, are missing out on the important learning opportunities that come from asking and answering questions, contributing to a discussion, and other forms of participation and engagement. Furthermore, a student (or anyone) viewing the video cannot maintain attention during lengthy recordings of classroom activities even if the classroom experience was engaging for those present in-person; that is why the asynchronous learning sequences being developed for blended learning (see Section above) are built around short video segments with questions or problems or other interaction interspersed. It seems clear that if MIT invests in auto-lecture-capture in more classrooms, it should be done at a level of quality and with a level of support that yields video that can be shared with MIT students in a future year, ideally after having been sliced into segments used in asynchronous learning sequences, and that if the faculty member so wishes can be shared broadly on OCW. Instructors wanting advice on how to do this well in the context of their own pedagogy can take advantage of individual consultations with members of the Digital Learning in Residential Education team in Open Learning. However, given the overall ambivalence that we heard, loud and clear, and given that we have not done anything anywhere near to a systematic needs assessment survey, our committee cannot make a recommendation as to how many classrooms, of which sizes and types, should be provided with auto-lecture-capture equipment.

We learned of some in-person classes wherein the instructor creates their own recordings by using Zoom and a lavalier microphone to capture their screenshared slides or tablet content, and audio. This method is less effective for highly interactive subjects that rely on class discussions and other forms of active student engagement, and for instructors who teach using whiteboards or chalkboards and/or who roam while they teach. In cases where it is possible, the cost of doing this is low, although the quality of the video that results may limit its utility. To the extent that this is an option for some purposes, this may reduce the need for auto-lecture-capture equipment; this further highlights the importance of a comprehensive, systematic assessment of classroom technology needs, moving forward.

All the examples above, as well as the evolution in the kinds of activities that the instructors of MIT want to see happening in their classrooms that is associated with the increase in blended learning, provide strong support for the RIC16 recommendation that what we need is a standing Classroom Advisory Board whose work starts from a systematic – and ongoing -- assessment of pedagogical needs across classes in different disciplines, of different types, sizes and levels and, flowing from these pedagogical starting points, guides and prioritizes the much needed investments in MIT's classrooms.

II.D Assessing Learning

During remote teaching, faculty and instructors stepped back and considered what they really wanted students to learn and how to best support and measure that learning. Often instructors came to realize that specific student learning outcomes were more accurately and effectively measured through instruments other than written timed exams. This led to a better alignment of types of assessments and grading (alternate ways for students to demonstrate understanding) with learning outcomes. Faculty and instructors across departments shared their use of: shorter, more frequent, lower stakes assessments; their moves away from timed, written exams; and new kinds of assessments - developed for use in remote instruction, but with affordances that transcend modes of instruction.

In addition, several faculty shared their use of alternative and/or flexible grading policies & schemes.

It is worth noting that many of the alternative assessments developed and utilized during the pandemic help support and foster student well-being, these benefits are highlighted in many of the practices below.

II.D.1 Shorter, more frequent, lower stakes assessments

Shorter, more frequent, lower stakes assessments allow students to practice retrieval and, if the exams are carefully developed, can scaffold student learning of more complex concepts and skills/tasks. This is relatively straightforward to implement, certainly more straightforward than some of the examples that follow, although if the traditional course structure was organized around 1 or 2 large midterm exams and a final, some reworking is required. In addition to positive consequences, we did also hear some reports of an unintended downside: notwithstanding their shorter duration and lower stakes, the increased frequency of assessments seemed in some cases to increase student stress

(rather than decrease it as intended). This additional stress can be reduced with overt, explicit messaging about the purposes of the more frequent exams, and may also be lower when students are not being tested under remote, pandemic, conditions. Instructors may also reduce student stress by setting consistent weekly/biweekly quiz and assignment schedules and putting assessment/assignment dates in Canvas so students can keep track of competing deadlines across their classes.

To give one specific example from BCS, during the pandemic the instructors in both 9.00 and 9.01 got rid of high-stakes midterms and the final (used to have 3 or 4 midterms plus a final, threw all of those out) and replaced them with frequent (6 to 8 per semester) formative assessments that were open notes, students were allowed to use all course materials while doing these quizzes. To make this possible, the 9.00 and 9.01 instructors created test banks in Canvas, with randomized instances of each problem, so that every student got a unique quiz. (The problem types employed to date are multiple choice, match two columns, fill-in-the-blanks and select-all-that-apply.) All of this was done for the first time during the pandemic; all of this is being continued into the future, with the plan being to add new problems to the test bank every year, and prune it also. Canvas allows instructors developing the test bank for next year to look at statistics for how students did on each problem on each quiz this year, so as to select and improve problems in the bank. The instructors will update, or delete, problems in the test bank; iterative improvement is the goal.

Another variant of this strategy was to introduce more frequent, lower stakes, assessments in the form of small projects done outside class-time. We heard in at least one instance that grades were hard to assign at the end of the semester because the scores on the various project-style assignments were high, much like we commonly see for pset scores. Yes, there were many good projects, but it was tough to discern those who kind of knew the material from those who really knew the material. This suggests developing project assignments with more detailed rubrics and/or more scaffolding, or perhaps incorporating in-class quizzes or oral presentations into the mix.

A third variation of this innovation in subjects where the traditional `high-stakes' assessments were papers was the use of Canvas discussion forum posts to improve writing skills in a 'lower-stakes' format. Students were required to submit their posts prior to class discussion in person. This format allows students to try out analysis of the ideas of others, or the making of their own arguments, without the 'pressure' of having to produce a paper.

II.D.2 Alternatives to Traditional Written Exams

In 9.01, in addition to eliminating the midterms (see above) the instructors replaced the traditional final exam with the requirement that each student do a written report at the end of semester, due on the last day of classes. The students got five questions that they could work on for 10 days. Each question cut across multiple units of the course, requiring synthesis and thought. Students could use all their notes and course materials in developing their narrative answers to these questions. They were expected to submit one page narrative answers to each question. BCS faculty/instructors have found this to be a really good replacement for a final exam.

We also heard about instructors replacing traditional exams with alternative, oral, formats. Again, this is an innovation that was introduced during the stress of the pandemic but that instructors are choosing to continue. Examples include oral exams, requiring that students explain a concept or solve a problem, or debates, requiring that students argue an issue individually or in teams. One or the other may be more appropriate in different types of subjects. When used effectively, these formats assessed comparable learning outcomes to traditional exams, but had added benefits such as clarifying student thought processes and giving students an opportunity to practice oral communication and/or teamwork. These are some of the reasons why instructors who introduced these end-of-semester assessments are continuing to employ them.

II.D.3 Alternatives to Fixed-Schedule Exams

During remote learning, when traditional, fixed-schedule, in-person exams were unavailable, upon reflection some instructors came to the conclusion that their design was motivated largely by convenience to the instructor, to make proctoring an exam easier and take less time. Remote learning largely broke this model, and instead faculty were encouraged to consider eliminating high-stakes end-of-semester assessments for many valid reasons. Coming out of the pandemic, some instructors have been experimenting instead with redesigning end-of-semester assessments in ways that seek to reduce stress without reducing the stakes.

For example, in 22.01 the instructor successfully petitioned the Committee on Curriculum to try a two-year experiment in which rather than being required to take a final exam at a fixed time, each 22.01 student had the option of taking the exam asynchronously, within a 24 hour period of their own choosing, at any time during the final exam period. These exams were open-book, open-notes, open-internet, meaning that the questions asked were quite different in character than on a three-hour, fixed-schedule, closed-everything exam. The instructor remained on Piazza throughout the week to answer questions. This form of end-of-semester assessment may work even better during the last week of classes, rather than exam week. Student feedback to the 22.01 instructor indicated that this experiment was successful in 2020 at both reducing student stress during what is normally the most stressful week of the semester, and at providing a fully integrated course assessment at the end of the semester. Further benefits were revealed in the Fall of 2021 when learning resumed in-person: the flexibility allowed students to better schedule their end-of-semester travel, relieving logistical and family burdens in addition to the benefits gained in 2020.

We also heard concerns, however, that asynchronous exams may increase the potential for cheating to occur. The 22.01 instructor sought to mitigate this risk by: (1) Writing completely new final exams each year, and (2) Including more open-ended questions incorporating design, scientific opinion, or open-ended problem solving to make cross-checking similarities in student answers much easier. In two years of offering asynchronous final exams, the 22.01 instructor did not note any instances of academic dishonesty. We heard from instructors in other departments, however, who had

experimented with asynchronous exams in 2020 but had detected inappropriate collaboration and have since returned to traditional proctored exams.

II.D.4 Alternatives to Final Presentations

Several instructors noted that during remote instruction the use of virtual poster sessions instead of the prior practice of students doing final presentations, enabled students to easily visit and learn from the posters of others, more so than they had learned via sitting in the audience of each other's presentations in the past. For in-person classes moving forward, many instructors plan to use in-person poster sessions -- with intentionally designed opportunities for student-student interactions. Others plan to keep the virtual format, given the affordances of remote access.

For additional information, see:

- Dr. Barbara Hughey discuss her use of virtual poster sessions during the fall of 2020. (A presentation on Alternative Assessments and Assignments in TLL's 2020-2021 Speaker Series.)
- An associated article from Open Learning summarizing the Speaker Series Panel Presentation on Alternative Assessments and Assignments.

In a different vein, several courses in Anthropology and History took advantage of the ease of making Zoom recordings to allow students to pre-record their final project presentations, in lieu of presenting them live in class. Often in these social science courses, the summative assessment takes the form of a research paper, which the student is then invited to present in front of their classmates during the last few class sessions. Professors found that offering students the opportunity to pre-record their presentations instead allowed students to spend more time on their presentation, and include photographs and video that they otherwise might not have been able to show in class. It also allowed students who would have difficulties presenting live in front of a group an equal opportunity to showcase their work. Faculty could give the option of having all students watch the presentations before class, and spend class time discussing them, or show the videos during class time. Faculty also found that the pre-recorded videos took less time than live presentations during class, and left more time for discussion.

II.D.4 Alternate/Flexible Grading Schemes

The use of more flexible grading schemes, that are also transparent and explicit, and that offer students more autonomy and control over their learning and demonstration of understanding -- can reduce stress and support well being.

As we already noted in Section IIA, we heard from many directions about straightforward variants of this idea along the lines of allowing students to choose to extend the deadlines of more assessments from many directions.

To give one example of a more substantial modification to a grading scheme introduced with these motivations in mind, students in WGS.160/STS.021 were offered what Ed Bertschinger called a "Choose your own adventure" grading scheme: they could choose among opportunities to earn up to 146 points (20 each from a final exam or a paper, 10 from a project, up to 72 from participating in discussions during the 24 classes over the

semester, and up to 24 from submitting weekly journals) and a grade of C/B/A/A+ if they earned more than 70/80/90/100 points. Every graded element in the course was optional; each student could mix and match the ingredients they chose to focus on to construct their own path to a grade. This innovative grading scheme worked well in this subject.

II.D.5 Improving Grading Efficiency & Effectiveness

Grading problem sets, quizzes, midterms and such has been a part of the work of TAs and instructors at MIT since the beginning. Before the pandemic, many instructors at MIT were unaware of Gradescope and had not considered exploring its use for these tasks. Now, its use is widespread and growing. Gradescope helps facilitate the delivery, logistics, and grading of assignments and tests. The benefits of using a tool like Gradescope include increased efficiency of grading, and the broader use of mandatory rubrics. Teaching staff no longer need to shuffle through paper, manually add points, or write repeated comments dozens or hundreds of times. Taking advantage of automatic grading for simple problem types saves graders more time also. Such increases in efficiency are good for the morale of the instructional team. It also gives them more time for more valuable interactions with students while teaching. The use of defined rubrics in Gradescope can also improve the efficacy of grading by allowing for more consistency and making it easy for the graders to give better and more substantive feedback to students. The ability to anonymize submissions can also help to reduce unconscious biases while grading.

II.E Looking ahead

Throughout Section II, we have described themes, highlights and extended examples of practices that originated when we were remote that are being incorporated into the MIT teaching and learning of today. In so doing we have aimed to provide some initial insights into a myriad of new ways in which instructors across the Institute are supporting student learning by augmenting, modifying, and in some cases redefining their subjects and their teaching practices. We hope that by highlighting and contextualizing this broad spectrum of practices we will help instructors across all of MIT learn from each other, going forward. We foresee many opportunities for more thorough investigations of some of the practices and themes identified in this report and more rigorous assessments of their impacts on learning at MIT. In Section III, though, for the benefit of instructors who turn to this report in the coming months and years we provide standalone snapshots of practices that we hope will be useful. Furthermore, during our discussion of themes and findings in Section II we have at a number of points made recommendations (flagged via bold-faced text) that go beyond highlighting and contextualizing effective practices; we collect these recommendations in Section IV.

Section III - Annotated List of Best Practices from Remote Instruction for Use in In-person Instruction

This section describes a variety of practices implemented by MIT instructors during the pandemic that they are continuing to employ because, in varying ways for varying examples, the practices also support and enrich in-person learning. In Section II we have put these practices into context, focusing upon the themes that have come through what we have heard from our information gathering across MIT and upon our committee's findings. In this section, we provide:

- a brief standalone description of each practice;
- the goals/benefits of the practice for in-person instruction;
- potential drawbacks
- specific enabling tools or technologies;
- the level of effort for adoption & use (low/medium/high);
- links for more information (if available).

We hope that this Section will be of value as a reference for instructors across MIT, both those who find items here after having read Section II for context and those who come back to this section in subsequent months. All the practices here are being used, to good ends, by colleagues at MIT; in this way, our report serves to help each of us to learn from the experience of many others.

The practices are grouped into three themes: Building Community, Supporting Well-being & Belonging; Enriching & Expanding the Learning Environment; and Assessing Learning.

Building Community, Supporting Well-being & Belonging: Engaging with Others

- **Instructor - Student**
  - Zoom for Office Hours, Alternate Meetings with Students
  - In-class Digital Community and/or Chat
  - In-class Polling
  - Journaling
  - Check-in Time with Students before Class
  - Pre-Class Topical Music
  - Increased & Enriched Roles of Undergraduate TAs and Mentors
- **Student - Student**
  - Technology-enabled Out-of-class Communication Space
  - Student Introduction Slides or Videos
  - Small Group, In-class Discussions
  - Peer-to-Peer Support
  - Virtual, Informal Meetings to Interact/Solve Problems - Pset Partners

Enriching & Expanding the Learning Environment

- **Alternate Structure & Delivery**

        - Blended Learning.
    - **Authentic Learning**
        - Remote Guest Speakers
        - Expert Judges/Panelists
        - Interactions with Students from Other Universities
        - Virtual Field Trips

Assessing Learning

- **Alternate Ways for Students to Demonstrate Understanding: Better Alignment of Learning Goals & Assessments**
    - Shorter, More Frequent, Lower Stakes Assessments
    - Alternatives to Written Exams: Oral Exams & Debates
    - Alternatives to Traditional Assessments: Scaffolded Projects & Design Challenges
    - Pre-recorded Final Presentations
    - Poster Sessions In Lieu of Final Presentations
    - Lightened End-of-Term Load
- **Alternate &/or Flexible Grading, Schemes, Policies & Processes**
    - Flexible Extension Policy
    - Flexible Grading Policy
    - Online Grading - Gradescope

Building Community, Supporting Well-being & Belonging: Engaging with Others

Instructor - Student Engagement

Zoom office hours

Description
(For a detailed description of use during remote instruction, see Section II)

Although a necessity during remote instruction, remote office hours can also support community, well-being and belonging for students for in-person classes. For in-person instruction, both remote and in-person office hours can be options for students.

Goals/Benefits

- Some students find Zoom more comfortable than being in a professor's office.
    - This may be especially helpful for first generation students with less cultural capital who may not know the importance of and/or expectations around office hours.

- Zoom can be useful in the evenings or at other times when either party does not want to travel to campus.
- Built in screen sharing makes it easy to review writing materials or other digital work together.

Potential Drawbacks

- *Maintaining the option of Zoom office hours may* enable students to eschew in-person interaction for convenience, for reasons of social anxiety, or others, at the expense of deeper engagement with the instructor and other students.

Enabling Tools and Technologies

- Zoom, Google Meet, or other web conferencing technology

The level of effort for adoption & use: **Low.**

Additional Resources

- Griffin, W., Cohen, S. D., Berndtson, R. Burson, K. M., Camper, K. M, Chen, Y. & Smith, M. A.. (2014). "Starting the Conversation: An Exploratory Study of Factors that Influence Student Office Hour Use." College Teaching. 62 (3): 94–9.
- Kim, Y. & L. Sax. (2009). "Student–Faculty Interaction in Research Universities: Differences by Student Gender, Race, Social Class, and First-Generation Status". Research in Higher Education. 50(5): 437–59.
- Uncovering A Huge Mystery of College: Office Hours. NPR All Things Considered, 2019.

In-Class Digital Community and/or Chat

Description

(For a detailed description of use during remote instruction, see Section II)

The Zoom chat surfaced as an efficient & equitable backchannel for student questions and engagement. Instructors found that a far greater number of students asked questions using the chat function that had ever asked questions during their analogous in-person classes. In many cases, students answered each others' questions in the chat. In other cases, a TA or a second instructor answered questions in the chat or asked the principal instructor to address specific questions from the chat.

Additionally, several instructors commented on the role of the chat in increasing the *efficiency* of the instructional team - with more people (both instructors and students) answering questions during class, students were able to ask better, more nuanced questions outside of class.

To enable backchannel questions during in-person instructions, instructors can use a variety of technology enabled tools such as Slido, or a shared, open-edit Google doc. All of these will need to be monitored by a member of the instructional staff during class, and students will need to have access to a web-enabled device in order to post questions and view responses.

For instructors who are concerned about student's use of technology in class - a low-tech alternative is to pause for 3 minutes during class and allow students to write down their questions on index cards. The cards can be collected (by another member of the instructional staff) and the most common or otherwise notable questions can be addressed "live" by the instructor.

Goals/Benefits:

- Provides an avenue for students to participate who are not as comfortable speaking out loud or are soft spoken.
- Students can get immediate, real-time answers to their questions, which can support follow-on learning.
- Instructional staff can save class time by triaging questions in real-time, answering simple questions in writing and saving off-topic questions to address outside of class.

Potential Drawbacks: none noted

Enabling Tools and Technologies

- Zoom chat in remote instruction
- Slido, Open-edit Google doc (you will be prompted to make a copy).

The level of effort for adoption & use: **Medium** or **Low** if one has assistance in checking the chat.

In-class Polling

Description

Although a variety of subjects pre-pandemic utilized a range of methods for polling students during class such as dedicated "clickers" (personal response systems); *PollEverywhere Kahoot, Socrative, Formative, Plickers*, many more instructors discovered the utility of quick checks of understanding via Zoom polls (and other software) during remote instruction.

The use of quick-checks of student understanding can give timely info to instructors regarding students' level of understanding, and can allow instructors to tailor their

explanations and delivery to best fit students' needs. General guidelines for action based on student responses are:

- If <30% correct: revisit concept as whole class
- If 30-70% correct: peer discussion and vote again
- If >70% correct: simply explain correct answer and move on
- For a 50 min class, use ~4 to 6 questions max

Students will need to have access to a web-enabled device in order to use polling software.

Goals/Benefits

Although in in-person instruction, polling can be accomplished with a show of hands, or with letters on index cards, the affordances of polling software make the process more efficient and easier for the instructor (software provides a histogram of student responses). In addition, polling software allows students to answer anonymously - which can reduce student anxiety and stereotype threat. Finally, such tools provide a quick mental break from knowledge absorption, turning the tables to rapid assessment and lightening the mood to allow for continued, deeper engagement in the next 5-15 minutes afterwards.

Potential Drawbacks: None noted

Specific enabling tools or technologies

Slido, Polling Software (PollEverywhere, Kahoot, Socrative, Plickers (for MCQs))

The level of effort for adoption & use: **Low** to **Medium.** The development of effective and useful questions may require a moderate amount of effort up front - but once questions are developed, they can be used in subsequent offerings of the subject. In addition - the creation of new questions becomes easier over time.

Journaling

Description

(For a detailed description of use during remote instruction, see Section II)

In general, journaling as a course-component can help to build meaningful connections between students and the instructor, and can support students' metacognitive development - by providing opportunities for them to reflect on their own learning and their progress in meeting the course learning outcomes. During the remote instruction - instructors across MIT utilized e-journaling (via Canvas, or electronically shared documents) to enable private sharing between students and instructors. Journals in in-person instruction can be either electronic or paper-based, but should be shared only with the instructor. When aligned with the class topic, journaling can be used as a form of weekly homework, or one of several options for a graded assignment. Journal entries

can be relatively short - typically ~300 words. If journaling is not relevant to the class material, it can be offered as a method for sharing feedback with the instructor. In either case, keeping the journals confidential can help students feel more comfortable sharing personal information.

Goals/Benefits:

- Students may find journaling less stressful than traditional assignment types.
- Instructors can get to know their students better and recognize when they may be struggling.
- Journaling can offer students a much-needed time for reflection about class materials, their MIT experience, or life in general.

Potential Drawbacks: None noted

The level of effort for adoption & use: **Low** to **Medium**.

Check-in Time with Students

Description

By using the first 5- to 10-minutes for informal discussions and check-ins with students, instructors can build a classroom community and can gain a better understanding of how students are doing in the course, and overall.

Goals/Benefits

- Creates a space where students feel comfortable to share their struggles.
- Students who feel safe and supported are likely to engage in more creative problem-solving.

Potential Drawbacks: None noted

The level of effort for adoption & use: **Low**.

Pre-class Topical Music

Description

During remote teaching, many instructors began playing music during the “MIT time” before the beginning of class (the 5 minutes between the top or bottom of the hour, and the start of class). This practice can easily be incorporated into in-person instruction. instructors can play songs with key lyrics connecting to the class or lecture topic. A cover slide highlighting the key lyrics can be displayed, and at the start of class, and a brief explanation of the song choice segues into the day’s lecture.

Goals/Benefits

- Connects class material to cultures across time and place.
- Incentivizes students to arrive on time
- Can minimize awkward silences before class

Potential Drawbacks: None noted

The level of effort for adoption & use: **Low** after the first time; Hard depending on the theme one is trying to find music for but relevant music can be identified well before the start of the semester.

Increased & Enriched Roles of Undergraduate TAs and Mentors

Description

(For a detailed description of use during remote instruction, see Section II)
Undergraduate TAs and Mentors can be used effectively in both in-person and remote instruction. This practice helped to elevate and empower a subset of students - and provided alternate learning support for all students in the class.

Goals/Benefits

- Students may feel more comfortable asking a near-peer for help.
- A lower student to undergraduate TA ratio (compared to the student to graduate TA ratio) allows students to get faster and more individualized support.
- Mentoring and/or a close relationship with an Undergraduate TA can help students learn the habits and perspectives they need to succeed in a particular subject, major, or at MIT generally.

Potential Drawbacks

- Undergrad TAs may not always have mastered material as much, though this can be mitigated by careful selection of undergrad TAs.
- Requires instructor (or grad TA) monitoring of time commitment of undergrad TAs, as their schedules are far more fixed and busy than those of grads. Weekly or biweekly meeting of instructor, grad TA if any, and undergrad TAs to hear from the undergrad TAs how their students are doing, which concepts have been challenging, etc, and (implicitly) to monitor their commitment is a good practice.

Additional Resources

For information on how Physics created an online mentoring program in 8.02 see this summary of Ed Bertschinger's July 2020 - TLL Speaker Series talk on the subject (includes video from the presentation.)

The level of effort for adoption & use: **Medium** to **High.**

Student - Student Engagement

Technology-enabled Out-of-class Communication Space

Description
(For a detailed description of use during remote instruction, see Section II)

Instructors have long leveraged the affordances of learning management systems (LMSs) like Stellar and Canvas to enable asynchronous communication with students. These systems are efficient and helpful in the distribution of announcements and supplemental, timely resources to students. Traditionally, though, LMS platforms enable primarily one-way communication - from instructional staff to students. More recently (pre-pandemic) platforms like Piazza were used (often, in tandem with an LMS) to facilitate multiple-way (instructor→ student, student → instructor; student ←→ student) communication. During remote teaching, instructors adopted a wider range of platforms to create digital spaces for asynchronous discussions and sharing of resources, and to distribute class announcements and facilitate Q&A.

Goals/Benefits

- Students can have their questions and concerns addressed in a more timely manner (while studying, doing psets, etc.) which supports follow-on learning.
- Depending on how the space is set up, students can respond to other students' questions. This can help build community.
- Depending on the settings, students can post anonymously, lowering the barrier for asking questions and minimizing stereotype threat.

Specific enabling tools or technologies
Slack, Piazza, etc. Instructors should keep in mind student privacy when using apps that do not require MIT-authentication. In some cases, apps may be integrated into Canvas sites.

Potential Drawbacks: None noted, provided students still use in-person communication media.

The level of effort for adoption & use: **Low** to **Medium.** Adoption is relatively straightforward, and requires monitoring the platforms and responding to student questions, etc.

Student Introduction Slides or Video

Description

In order to build community and enable all members of the class to get to know each other a bit better during remote instruction, some instructors asked students to create short introductions in a shared slide deck (Google Slides, PowerPoint, etc.) or to create a short (< 1min) video. This practice can easily be adapted for in-person instruction. Students can include a combination of images that have significance to them and can provide explanations in the presenter notes of the slides, or in supplemental documents if videos are used.

Goals/Benefits

- The instructor is introduced to the students and the students get to know each other at the start of the semester. The material can serve as a refresher later on.
- The slides can be shared synchronously, during the first class, or asynchronously before the first class meeting.

Potential Drawbacks

Not all students may be comfortable doing this at the start of the semester - instructors should be sensitive to students who are either resistant or scared to voice their concerns at doing so. Suggest not making it a requirement, rather a strong suggestion. Instructors may also provide multiple format options (e.g. written post or video) for students who are not comfortable recording video.

The level of effort for adoption & use: **Low.**

Small group, in-class discussions

Description

Many instructors made use of Zoom breakout rooms to create small-group, peer-peer learning opportunities - and to promote deeper engagement with content.

Although many instructors at MIT utilized small-group learning in their subjects prior to pandemic - the ease of creating and using virtual breakout rooms has opened the door for many instructors to include this practice in their in-person classes. Although it is difficult to enable small group (4-6 students/group) discussions in traditional lecture halls, and/or classrooms with fixed seating, think-pair-share activities in groups of 2-3 are possible in most classrooms. To enable more varied, larger group sizes - more classrooms should be equipped with flexible seating. A future Classroom Advisory Board can play an important role here.

Goals/Benefits

- Small group learning gives student the opportunity to discuss strategies, opinions and answers in a less-threatening environment (a small group of peers, rather than the whole class;
- It supports equity and inclusion by providing opportunities for all students to think about and talk about the topic, problem, etc. By randomly assigning "reporters" for each small group, a variety of student voices can be heard.
- Small group discussions promote a collaborative, rather than competitive culture.
- Small group activities can take as little as three minutes of class time, yet may allow students the neural processing time needed before being ready to take on new information offered by an instructor. It is also during these pair discussions that students may discover new confusions or points of disagreement about concepts with fellow students, which can drive questions to be asked of the instructor. *(from Tanner, 2017)*

Specific enabling tools or technologies

For in-person classes, no technology or tools are needed, however, as stated above, flexible classroom seating enables more varied student groupings and activities. In addition, the use of a shared Google doc, or any other vehicle for collaborative editing and viewing, can facilitate the large group share-out after the small-group/pair discussion.

Potential Drawbacks

Student social anxiety may inhibit discussion in some groups, leading to 1-2 students dominating the conversation. May be mitigated by instructors ensuring everyone is comfortable speaking up, and requiring equal participation.

The level of effort for adoption & use: **Medium.** Developing appropriate and engaging problems/questions/prompts for students to discuss and work on collaboratively in small groups can be challenging at first. Most instructors find that this becomes significantly easier with experience.

Additional Resources

- Smith, M. K., Wood, W. B., Adams, W. K., Wieman, C., Knight, J. K., Guild, N., & Su, T. T. (2009). Why Peer Discussion Improves Student Performance on In-Class Concept Questions *Science*, *323*(5910), 122-124.
- Allen D, Tanner K (2002). Questions about questions. *Cell Biol Educ 1*, 63-7.
- Tanner, K. (2017) Structure Matters: Twenty-One Teaching Strategies to Promote Student Engagement and Cultivate Classroom Equity, *CBE—Life Sciences Education*, Vol. 12, No. 3
- SERC - Active Learning

Peer-to-Peer Support

Description
(For a detailed description of use during remote instruction, see Section II)

On a rotating basis, each week a student within a small team/cohort messages their group to express their openness to support those who ask. Students can volunteer for the role, or all students can be expected to serve at some point in the semester. The designated student can listen, brainstorm together, and/or suggest resources on campus for a peer experiencing academic or emotional struggles. This technique works equally well for remote and in-person classes. Students can be assigned roles or can volunteer. Instructors should provide designated students with lists of campus resources in case they are not aware of all that is available.

Goals/Benefits

- A compassionate team environment improves wellbeing.
- Students who feel safe and supported are likely to engage in more creative problem-solving.
- Students may be more likely and willing to collaborate with each other when they have formed an informal bond.

Potential Drawbacks
Potential issues with peer-peer interactions can be mitigated by instructor/TA moderation. It should be noted that The groups don't necessarily meet in person. Interactions can involve only email or chat exchanges. The instructor should not have to do much, if any moderation.

The level of effort for adoption & use: **Low** to **Medium** depending on instructor involvement. Lower effort is required in classes where students are already teamed up for other reasons.

Virtual, informal meetings to interact/solve problems / Pset Partners

Description
(For a detailed description of use during remote instruction, see Section II)

When students are living on campus, they often self-assemble into groups to work on problem sets and/or other homework assignments. Although this is a very effective practice for many students, others may be left out of these groups for a variety of reasons (scheduling issues related to sports or jobs; lack of connectedness to others in the class; etc.). Pset Partners, the site developed in the Mathematics Department to

facilitate the grouping of remote students - can also be used during in-person semesters to create more equitable and inclusive study-groups. Students with compatible schedules and preferences for collaborating/studying can be grouped with each other. Links to the active site and Sandbox version are available here: https://psetpartners-test.mit.edu/about.

Goals/Benefits

- Lowers the barrier for students to find peers with whom to collaborate on psets and other assignments.
- Promotes more inclusion in psetting groups.

Potential Drawbacks: Some courses reported that students in Pset groups were unresponsive to each other, or didn't show up at agreed-upon times. Mitigation strategies include signing a group contract at the start, and allowing for instantaneous, dynamic group reassignment. Finally, some students really don't want to work in groups, and we should consider whether requiring groups is always beneficial.

The level of effort for adoption & use: **Low** (To include this practice in a class, contact the administrators at psetpartners@mit.edu)**.**

Enriching and Expanding the Learning Environment

Alternate Structure & Delivery / Multiple Modes of Engagement

Blended Learning

Description

(For a detailed description of use during remote instruction, see Section II)

Thoughtfully designed flipped/blended & hybrid courses transform what happens in a classroom. By considering what synchronous classroom experiences best support the desired learning (e.g., group, collective problem solving; small-group interactions with instructors and/or TAs; hands-on collaborative experiences, etc.), instructors can then collect, create and leverage appropriate asynchronous content and activities to prime and enable subsequent classroom experiences.

Goals/Benefits

Specific enabling tools or technologies

Often, blended learning involves the creation and/or use of appropriate video content for the asynchronous segments of the course.

Services that support faculty in the creation and use of video, simulations, and or software may be particularly important. And of course, some type of equitable funding model is essential.

In addition, text-based resources, questions, and/or small table-top experiments may be used in conjunction with or in place of video content and may require less technology specific expertise.

Potential Drawbacks: Instructor-generated content may vary wildly in quality, mitigation includes pre-training in best practices and spot-checking end results. (See note above.)

The level of effort for adoption & use: **Medium** to **High.**

Additional Resources

- Blended Learning. Center for Teaching & Learning at Columbia
- Professors Wolfgang Ketterle and Lorna Gibson describe their uses of flipped classrooms (blended learning) to better support learning and engage students.

Authentic Learning

Remote Guest Speakers

Description
(For a detailed description of use during remote instruction, see Section II)

During remote teaching, instructors leveraged the affordances of Zoom to enable presentations by guest lecturers (often experts in the the field) from any part of the world.

Goals/Benefits
By eliminating the need (and time and expense associated with travel) - remote presentations allow students to learn from experts from across the globe. Often, these remote lecturers provide important, relevant, authentic perspectives that can motivate students and augment their learning and understanding in the course.

Potential Drawbacks
None noted, provided instructors don't use too many in order to avoid doing the teaching themselves. Some students reported such classes turning into passive presentations.

To avoid passive presentations, to avoid passive presentations, members of the teaching team may need to facilitate interactions between the in-room and the remote participants. This may involve hardware such as audio and video equipment and or additional members of the teaching team to "stage managing the process so that the speaker knows what to do and how to connect. A knowledgeable AV team and trained

TAs may be particularly helpful. These supports can significantly lower the effort required for faculty, but may come at a significant external cost

The level of effort for adoption & use: **Low** to **High.**

Expert Judges & Panelists

Description
(For a detailed description of use during remote instruction, see Section II)

In project-based classes with a presentation component, Zoom allows instructors to bring in guest audiences or critics from any location. Examples of using this successfully range from inviting expert practitioners to share feedback to inviting an entire middle school class to attend a presentation and ask questions. This practice can yield richer feedback for students and challenge them to tailor their presentations to audiences with different backgrounds.

Goals/Benefits
By eliminating the need (and time and expense associated with travel) - remote panels and judges can include individuals from anywhere in the world. Often, remote panelists and judges provide important, relevant, authentic perspectives that can motivate students and augment their learning and understanding in the course.

Potential Drawbacks: None noted

The level of effort for adoption & use: **Low** to **High.** The complexity of the logistics may depend on the connection with, and location of the panelists and/or judges.

Interactions with students from other universities

Description
(For a detailed description of use during remote instruction, see Section II)

Using Zoom or other teleconferencing software, students can interact with students from other universities who are engaged in the same topics that they are learning about. This is particularly impactful when the student groups bring diverse experiences and insights to the material, and can learn from each other in an informal, but supported environment.

Goals/Benefits
This practice can provide more authentic interactions (in language classes, for example), and can bring more diverse perspectives to the discussion of a particular topic.

Potential Drawbacks
While diverse perspectives are beneficial, conflict can arise if students are not prepared to navigate cultural differences with respect and humility. Mixing time zones can also cause scheduling issues which can be easily dealt with using standard tools (WhenIsGood, Doodle, etc.) and personal integrity.

The level of effort for adoption & use: **Low** to **High**. The complexity of the logistics may depend on the connection with, and location of the other university and/or group.

Virtual Field Trips

Description
(For a detailed description of use during remote instruction, see Section II)

Using Zoom or other teleconferencing software, students can "visit" other locations (cities, museums, archeological, architectural and/or construction sites, etc.) with relevance to the course. Depending on the remote experience, this may require a partner/additional instructor "on site" in the remote location, or may be accomplished using Google Earth or the "Street View" in Google Maps.

Goals/Benefits
Can provide more authentic learning opportunities, enabling students to see, and remotely experience real environments in all their complexity.

Specific enabling tools or technologies: Zoom, Google Meet, Google Earth, Museum websites

Potential Drawbacks: None noted

The level of effort for adoption & use: **Low** to **Medium** depending on the particular environment /situation of interest, and the need for a partner on the ground in the remote location.

Assessing Learning

Better alignment of learning goals & types of assessments (alternate ways for students to demonstrate understanding)

Shorter, More Frequent, Lower Stakes Assessments

Description
(For a detailed description of use during remote instruction, see Section II)

Shorter, more frequent, lower stakes formative and summative assessments allow students to practice retrieval and, if the exams are carefully developed, can scaffold student learning of more complex concepts and skills/tasks. These types of assessments are relatively straightforward to implement, although the traditional course structure and design (topics and lectures organized around one or two large midterm exams, and a final) - will need to be reworked. During remote instruction, there were some reports that more frequent testing seemed to increase student stress (rather than decrease it as intended). This additional stress can be reduced with overt, explicit messaging about the purposes of the more frequent exams, and may be lower, when students are not being tested under remote, pandemic conditions.

The goals of the practice
By more uniformly distributing the assessments throughout the semester, students have multiple opportunities to receive feedback on their learning and understanding and to correct misconceptions and confusion in a timely manner. In addition, in general more frequent, lower stakes assessments reduce student stress - by reducing the weight (and therefore the impact on overall course grade) of any single assessment.

Potential Drawbacks
Some students may struggle to keep track of many frequent assessments across multiple classes, but this can be mitigated by sticking to a consistent schedule and noting assessment dates in the Canvas calendar.

The level of effort for adoption & use: **Low** to **Medium**.

Alternatives to Written Exams: Oral exams & Debates

Description
(For a detailed description of use during remote instruction, see Section II)

Due to concerns about administering written exams virtually, some instructors replaced traditional exams with alternate formats. Oral exams requiring that students explain a concept or solve a problem, or debates, requiring that students argue an issue individually or in teams, may be appropriate in different types of subjects. When used effectively, these formats assess comparable learning outcomes to traditional exams, but have added benefits such as clarifying student thought processes and giving students an opportunity to practice oral communication and/or teamwork.

Goals/Benefits
Provides a more realistic and nuanced measure of student understanding

Potential Drawbacks: None noted

The level of effort for adoption & use: **Low.**

Additional Resources

- Professor Heidi Nepf discusses her use of oral exams in 1.061 - Transport Processes in the Environment during fall 2020 & spring 2021.
- Professor Jing Li discusses her use of debates in 15.020 - Economics of Energy, Innovation, and Sustainability, during fall 2020.
  (Both videos are part of the TLL Fresh Perspectives Video Series.)

Alternatives to Traditional Assessments: Scaffolded Projects/Design Challenges

Description
During the pandemic, instructors of project-based courses were forced to narrow the focus of hand-on experiences. This narrowing of focus pushed instructors to carefully align project goals (or sub-goals) and specific activities. Creating projects and tasks that more closely align with specific learning goals is more upfront work for instructors - but is likely to result in more robust and widespread achievement of the course learning outcomes.

Goals/Benefits
Well aligned learning goals, learning activities and assessments promote and support more enduring understanding for students - and provide better measurements of the extent and quality of student learning.

Potential Drawbacks: None noted

The level of effort for adoption & use: **Medium** to **High**. Requires time and effort to redefine course learning outcomes - and to develop a collection of intermediate, progressive activities, assessment and milestones for student learning.

Additional Resources

- Prof. Denny Freeman and Dr. Dawn Wendell discuss their redesign and scaffolding of the projects in 6.A01- Mens et Manus during the fall of 2020. (Part of the TLL Fresh Perspectives Video Series.)

Pre-recorded Final Presentations

Description

(For a detailed description of use during remote instruction, see Section II)

Offering students the opportunity to pre-record their presentations allows students to spend more time on the presentation, and if relevant, include photographs, video and other supporting material that they might not be able to show in a live, in-class presentation. Faculty can; have all students watch the presentations before class, and spend class time discussing them; or show the videos during class time.

Goals/Benefits

- By pre-recording their presentations, students can spend more time on the presentation, and include photographs and video that they otherwise might not be able to show in class.
- Showing of pre-recorded presentations generally requires less time than live presentations (fewer edge-effects) and can leave more time for discussion.
- Students who may have difficulty presenting live, in front of a group (for any number of reasons) have the opportunity to more accurately demonstrate their work (and their understanding) through recorded presentations.
- May support student well-being

Potential Drawbacks

None noted. In order to prevent students from spending too much time recording and editing "slick/glitzy" videos (at the expense of developing richer conceptual understanding), instructors should clearly state (and restate) expectations and provide examples of successful presentations.

The level of effort for adoption & use: **Low** to **Medium**.

Poster Sessions in Lieu of Final Presentations

Description
(For a detailed description of use during remote instruction, see Section II)

During remote instruction, these were done virtually, enabling students to easily visit and learn from the posters of others. For in-person classes moving forward, poster sessions could be in-person (with intentionally designed opportunities for student-student interaction); or virtually.

Goals/Benefits

- The creation of posters (virtual or traditional) may allow students to demonstrate a more nuanced and/or sophisticated understanding of concepts. It also provides opportunities for students to demonstrate higher-order learning (e.g., their ability to explain, compare and apply their understanding) - particularly with respect to questions from peers and instructors.
- The creation of virtual posters (and/or other virtual demonstrations of learning) may reduce barriers for poster creation and improve equity (some students may not have access to paper-based materials and tools needed to create traditional posters).
- The virtual set-up of the poster session allows both instructors and students to visit and learn from more posters in a given time frame.
- Students may be more comfortable asking and answering questions of peers, virtually.

Potential Drawbacks: None noted

Specific enabling tools or technologies: Gather

Additional Information

- Dr. Barbara Hughey discuss her use of virtual poster sessions during the fall of 2020. (A presentation on Alternative Assessments and Assignmentsin TLL's 2020-2021 Speaker Series.)
    - An associated article from Open Learning summarizes the Speaker Series Panel Presentation on Alternative Assessments and Assignments.

The level of effort for adoption & use: **Low** to **Medium.**

Lightened End-of-Term Load

Description
Arrange material to place less emphasis on material that occurs towards the end of the term.

Goals/Benefits

- The end-of-term is often stressful for students (and instructors!) as projects and exams pile up. Lessening demands towards the end of term when possible can allow students the flexibility to focus on preparing for exams and projects.
- Supports student well-being

Potential Drawbacks: None noted

The level of effort for adoption & use: **Medium.**

Flexible Exam Scheduling, Including Final Exams

Description
Allow students to take any exam, including a final exam, during a period of their choosing within a fixed window of a few days. Suitable for open-books/notes/internet exams e.g. those with relatively open-ended problems with a design orientation. Submit exams via Canvas or similar application. This kind of end-of-semester assessment may be well-suited for the last week of classes.

Goals/Benefits

- The end-of-term is often stressful for students (and instructors!), especially scheduling final exams on top of final projects and travel home. Making exams flexible, especially finals, relieves one source of this stress.
- Supports student well-being, allows students to choose the day in which they can focus and perform best to show what they have learned, NOT what they can remember at a particular point in space-time, when they may be unusually tired, sick, or distracted by personal concerns.

Potential Drawbacks:

- Increased risk for cheating, mitigation strategies include writing completely new exams each year, and crafting more open-ended problems to make cross-checking similarities between student answers much easier
- Slightly increased workload for instructor, requires availability for questions over a longer period. Mitigation strategies include using Piazza combined with allowing

students to complete the exam within a 24 hour period (so instructors can check questions once a day at a reasonable time).
- Loss of benefits of in-person proctoring, including live Q&A for clarifications. Mitigation strategies include 1-2 Zoom exam hours specifically for this purpose.
- Instructors may need to provide clear guidance for students who traditionally depend on stricter, externally imposed work and exam schedules.

The level of effort for adoption & use: **Low** to **High**, depending on the deed to develop new exam questions, annually.

Alternate Grading Schemes, Policies & Processes (Better aligning our grading with our goals for learning)

Flexible Extension Policy

Description
Allowing built-in flexible extension policies such as "three (free) two-day extensions per student" or automatic "drops" of the two lowest homework scores, can significantly reduce student stress. The exact nature of the extension can vary depending on the class, but the key is that students know these extensions will be granted and can choose if/when to apply them.

Goals/Benefits:
- Students have some breathing room, and can choose to use it at times that are difficult for them.
- Instructors spend less time figuring out whether to grant extensions for students
- Constraints on the policies (e.g., a limit on how long the extension is) still allow grading/feedback to be done on time.
- Supports student well-being

Potential Drawbacks: None noted

The level of effort for adoption & use: **Low,** especially if the extension requests are handled by TAs or software.

Flexible Grading Policy

Description
(For a detailed description of use during remote instruction, see Section II)

Allowing students to accumulate points in multiple ways (a "choose your own adventure" approach to grading). For example: up to 10 points for a group project; 20 points for a final paper; 20 points for a written exam; 70 points for participation; any student with at least 90 points earns an A.

Goals/Benefits:

- Can increase learning by decreasing students' anxiety around grades
- Can help adapt to students who need to miss class for an extended illness
- Supports student well-being

Potential Drawbacks: Can weaken link between learning outcomes and grade if not properly implemented ahead of time (See level of effort required).

The level of effort for adoption & use: **Medium** to **High** before the term, as it requires rethinking one'e grading policy. **Low** effort throughout the semester - after the criteria has been developed.

Online Grading - Gradescope

Description
(For a description of use during remote instruction, see Section II)
Gradescope helps facilitate the delivery, logistics, and grading of exams and assignments. There are four main categories of how MIT courses use the tool.

1. Online, timed assessments are delivered as a PDF and students upload completed files (easy, analogous to in-person exams, quizzes)
    a. Remote completion - either synchronously or asynchronously within a longer time period or...
    b. In-person proctoring with students using their own computers
2. Paper assessments that staff upload scans for the grading process (easy but requires a scanning step, analogous to in-person exams, quizzes)
3. Online assessments with partial or 100% auto-grading (more advanced setup, analogous to in-person exams/quizzes)
4. Any type of assignment that requires staff grading and feedback, even essays or code
    a. Remote completion - timed or untimed, synchronous or asynchronous or...

b. In-person proctoring with students using their own computers

Goals/Benefits

The use of Gradescope can increase the efficiency of grading and facilitate the use of mandatory rubrics. Teaching staff no longer have to shuffle through paper, manually add points, or write repeated comments hundreds of times. Decreasing the time to grade is extremely important for TA morale and increased time for research or valuable interactions with students while teaching. The use of defined rubrics in Gradescope supports more consistent grading. The ability to anonymize submissions helps reduce subconscious biases while grading. The students also gain transparency from the rubrics to learn from mistakes and trust the process. By taking advantage of automatic grading for simple answers, graders save more time. The tool also has features to address common student customizations like extensions. The Canvas Speedgrader tool also has many of these benefits but fits better for essay grading than problem sets or exam grading.

Potential Drawbacks: None noted.

The level of effort for adoption & use: **Low** to **Medium**.

Section IV. Recommendations

IV.A. Overarching Recommendations

Our principal recommendation is simple. We recommend that all faculty and instructors across MIT read Section II, Themes and Findings, and that after having done so (whether immediately after, or months later) they pick and choose examples of best practices from remote instruction for use in in-person instruction from Section III to deploy, reshape and improve upon. Our principal goal in gathering input from across MIT and presenting it in the form of this report is to enable all instructors to benefit from the experience, perspective and wisdom of colleagues across the Institute; hence this overarching recommendation.

We hope that reading this report will contribute in its own small way toward maintaining a culture of reflection upon, and improvement of, pedagogy across MIT. This has long been a collective strength of MIT; we believe that carrying the increased focus on learning goals and on how we teach that became a necessity in 2020 forward into the coming years will serve the MIT community, and the education of MIT students, well. As instructors pick up examples of practices that they learn about from their colleagues via our report, reinvent them with their own learning goals and pedagogy in mind, and as these further developments ripple and spread, new strands will be woven into the MIT tapestry of community, well-being and belonging, enhancing engagement and enriching and augmenting the learning environment.

As instructors do the work of weaving the tapestry of MIT they will be able to rely upon expertise in, and support in various forms from, the Teaching + Learning Laboratory and the Digital Learning in Residential Education team within Open Learning. This is in addition to the expertise that resides in different ways within individual departments across MIT, for example via the department- and school-based Digital Learning Lab members. We commend the significant and valuable efforts being made by the people in these offices and roles; the contributions they made to the MIT educational enterprise during the pandemic and, more importantly now, warrant continued and enhanced investment.

We also hope that in the coming year(s) the instructors and students serving on the Committee on the Undergraduate Program, the Committee on Graduate Programs, and the Committee on Curricula will, in partnership with the Teaching + Learning Laboratory, further investigate themes and practices identified in this report and, as the time for this comes, more rigorously assess the impacts of these practices on learning at MIT.

These overarching recommendations in Section IV.A. flow from everything that we have described in Sections II and III. In Sections IV.B and IV.C below, we identify two further recommendations that each arise from specific discussions earlier in the report.

IV.B. Classroom Advisory Board

Based upon a variety of positive developments in pedagogical practices with varying contexts arising across the Institute – described in Sections II.B.1, II.C.1 and II.C.2 – we strongly support the recommendation from TaskForce 2021 RIC16 to create a Classroom Advisory Board. The RIC16 report states:

> "*[RIC16 recommends] developing a standing advisory board composed of faculty, staff and students to spearhead strategic planning of classroom spaces … and the design of classroom spaces to integrate more interactive teaching practices. The group would work with a range of stakeholders to help set a strategic, intentional plan for academic spaces. …*
> *The "Magic of MIT" is real engagement, building together, learning together. The group would work to adapt classrooms to future learning needs through a strategic, high-level lens.*
>
> *RIC 16 proposes a standing Classroom Advisory Board, jointly charged by and reporting to the Chair of the Faculty, the Vice Chancellor, and the Chair of P-CRSP. The board would be co-chaired by a Faculty member and the Registrar. General membership should include students; Faculty selected from all five schools and the College and selected so that the Faculty membership of this Advisory Board has at least one overlap with the membership of the Committee on the Undergraduate Program and the Committee on Graduate Programs (CGP); and representatives from the Registrar's Office, Provost's Office, the Digital Learning in Residential Education group in Open Learning, the Teaching + Learning Lab, MIT AV, MVP, and Facilities.*" [The RIC16 report continues, with suggested elements for the charge to the Classroom Advisory Board.]

As we distilled what we heard from across the Institute into the themes and findings in Section II, we saw many ways in which a board as recommended by RIC16 would enhance MIT's ability to deliver its educational mission.

In gathering input from instructors across MIT, we found many ways in which our teaching and learning is changing, as we implement, or seek to implement, new practices or new insights gained while navigating remote learning. In Section II.B.2, we described how instructors seek to reproduce some positive aspects of Zoom in in-person classrooms. The engagement that is at the heart of the best in-person learning experiences is certainly better overall than what we lived through when learning and teaching remotely. That said, the capacity for students to see each other's faces as they did on Zoom is now being missed in classrooms in which the students are not facing each other. This is prompting instructors to prefer classrooms that are more semicircular, with fewer rows, rather than rectangular rooms that are oblong and deep. Others told us about reproducing breakout room discussions in in-person classrooms — for this purpose seats and possibly tables that can quickly and easily be reconfigured are key. Generalizing, what we heard from many directions about pedagogical goals and a new focus on better achieving those goals in reconfigured and flexible classroom arrangements made it clear that changing pedagogical goals must be front and center as MIT plans investments in its classrooms over time. The makeup of the Classroom Advisory Board envisioned by RIC16 makes it well-suited for supporting this critically important need. A key part of the charge to the Board (both instructors and students) should be to stay broadly informed about (rapidly) changing pedagogical needs and goals across MIT.

In Section II.C.1, we described an increasing focus on blended learning, with instructors at MIT using asynchronous activities that students access online before and after class (that instructors and students have more experience with now than before the pandemic) to set up, create, support, and enhance the synchronous activities that happen in-person in the classroom. The key, we saw, is to use the in-person time (when students and instructors are physically together in an MIT classroom) to create rich and meaningful engagement and active learning experiences, from which the magic of MIT can emerge. The specifics of these in-person experiences will be different in different disciplines and subjects, and for students at different levels. Much that we heard, though, highlights the importance of investing in our classrooms in ways that support the changing pedagogical goals of today, and tomorrow. We need spaces designed flexibly in ways that make many different kinds of active learning experiences and engagement flow naturally. Here again, the makeup of the standing body envisioned by RIC16 is ideal as it will bring instructors and students with their fingers on the pulse of MIT pedagogy together with key staff from the offices with relevant responsibilities. A Classroom Advisory Board like this can do strategic planning for classroom spaces that flows from the evolution of learning and teaching in different contexts across MIT.

In Section II.C.2 we described myriad examples of how instructors across MIT are finding new ways to increase the authenticity of the in-class learning experience that rely,

differently in different cases, on technology in the classroom. The landscape of pedagogical goals in this regard, and consequent technology needs, are rapidly evolving. We encourage the Classroom Advisory Board to undertake a survey early on to more systematically map out the landscape of classroom technology needs, and to establish formal lines of communication so as to hear from instructors and departments on a regular basis going forward.

We heard about many tremendous new ways of increasing the authenticity of our students' learning experience by bringing others (experts in varied senses of the word, alumni, leaders of a virtual field trip, students from elsewhere, etc.) into our classrooms via videoconferencing. This provides a strong motivation for investing in technology improvements in classrooms across MIT. The work of our committee provides clear pointers but not a roadmap. We have not done a systematic survey of these new, increasingly authentic, aspects of the learning goals for MIT students and so cannot prioritize investing in videoconferencing capabilities in this or that classroom at this or that level of quality.

At the same time, we heard from sectors of MIT where people just need the ability to quickly, easily, and flexibly project a laptop or a tablet onto a screen when desired – something that people from other sectors saw as already part of their expectation for the classrooms of today. A granular, locale by locale, assessment of unmet pedagogical needs that constitute low-hanging fruit for investment in classroom technology is called for.

We also heard much discussion, and considerable ambivalence, concerning the desirability, and undesirability, of automated video recording of classroom activities, most often lectures. For some, the first consideration is that such recordings are a resource for students who miss class or are studying for a test. Others focus on the concern that lengthy recordings do not come close to being reasonable substitutes for in-person experiences, and that students who make the mistake of treating these recordings as a replacement for attending class in person miss out on the learning that comes from participation and engagement. There does seem to be a consensus that *if* MIT invests in auto-lecture-capture in more classrooms, it should be done at a level of quality and support that yields video that can be shared with MIT students in a future year and more broadly on OCW if the instructor so wishes, ideally sliced into short video segments with other online activities interspersed. Given the overall ambivalence that we heard, loud and clear, and given that we have not done a systematic assessment of classroom technology needs, we cannot make a recommendation as to how to prioritize investing in auto-lecture-capture equipment and supporting its use relative to investments addressing the needs expressed in the two preceding paragraphs. MIT needs an approach to investing in classroom technology that is planned, strategic, and grounded in pedagogical goals. A future Classroom Advisory board should assess and balance the needs and goals for classroom video recording (pedagogical goals; student needs, instructor autonomy; ease of recording and video quality) with the needs and goals for other investments in classroom technology, configuration, and flexibility.

The examples above of different, potentially competing, pedagogically driven needs for investments in classroom technologies, as well as the evolution in the kinds of activities that the instructors of MIT want to see happening in their classrooms that is associated with new modes of engagement that require new and flexible classroom layouts and the increase in blended learning can play off each other in interesting ways in specific classrooms. For example, investment in classroom technology should support the pedagogical goals of tomorrow rather than locking in modes of teaching that instructors are seeking to change. This all needs to be looked at together, with a strategic perspective that is grounded in evolving learning and pedagogical goals. These considerations provide strong support for the RIC16 recommendation that MIT needs a standing Classroom Advisory Board whose work starts from a systematic – and ongoing -- assessment of pedagogical needs across classes in different disciplines, of different types, sizes and levels and, flowing from this, guides and prioritizes much needed investments in MIT's classrooms. To ensure that its guidance is indeed grounded in pedagogical goals, the Board needs to include instructors and students from across MIT and should be co-chaired by a faculty member or senior lecturer; to ensure that its guidance is informed regarding realities and technologies, the Board needs to include staff from the relevant offices and should be co-chaired by the Registrar, who "owns" MIT's classrooms.

IV.C. Thanksgiving Break

As we reported in Section II.A.1, we heard from many directions that, although it was introduced in Fall 2020 as a part of MIT's pandemic-response for that semester, a one week break over Thanksgiving during which classes did not meet was a valuable, and much valued, improvement to MIT's academic calendar. We recommend that this change should be perpetuated because it serves the well-being of students and instructors alike while at the same time supporting teaching and learning. In our Fall calendar, the Thursday and Friday of that week are official holidays and little teaching or learning happens on the Wednesday. Giving up two teaching days (the Monday and Tuesday) to create a full week break would give everyone a chance to recharge before the final weeks of the semester, which serves to improve both well-being and learning. Furthermore, if we had a Thanksgiving-week defined as such, the times that students are away would synchronize, rather than conflicting as they do now with everyone making their own time for travel, disrupting classes on the Monday and Tuesday before Thanksgiving and the Monday after.

Our committee discussions took us much of the way toward designing an implementation of this recommendation, but this is not our role. We recommend that the appropriate faculty committees (CAP, CUP and CGP) and the Registrar's office charge an implementation group with doing a full investigation of how best to introduce a one-week break over Thanksgiving in MIT's academic calendar. As our own committee is an ad hoc committee whose work will conclude with the circulation of this report, we will not play a role as a committee in developing this recommendation further; however, there are individual members of the committee who would be happy to contribute. Finalizing an implementation plan will require careful consideration of various significant logistical challenges; however, the resulting gains to both well-being and learning from this change to the Fall calendar makes doing so worthwhile.

V. Final Thoughts

Although there can be no debate that teaching and learning throughout the pandemic: were exhausting and stressful and that goals for both were compromised, at the same time MIT faculty and instructors found many new ways to provide robust, meaningful learning experiences and engagement; and to support student well-being and belonging. In highlighting the wide range of innovative practices that emerged and that instructors are continuing to employ, this report gives context and motivation for the use of these practices moving forward in ways that improve teaching and strengthen learning at MIT. For the most effective adoption and adaptation; and to better support student learning and growth, the MIT teaching community should continue to carefully examine the constraints and variables of each semester, and thoughtfully consider: **how** best to teach, **where** best to teach, and **when** best to teach. We hope this report provides a starting point for those reflections and actions.