

E-Learning Interim Report
MIT Council on Educational Technology
December 18, 2010

“Whatever we do, I think we should strive to really capture the imagination and excitement of our student population and the larger global community, and have some high risk high payoff ideas on the table.”

– CET Member, November 2010

CET’s Charge

Provost Reif charged the MIT Council on Educational Technology (CET) to provide the strategy to enable MIT to move from the current educational state to a future state in which:

- An MIT education will increasingly consist of experience-based learning that is hands-on, globally connected, and research-intensive (e.g., through UROPs).
- An MIT student’s residential experience will integrate living and learning through technology-enabled residence-based education that supports the very best in-person and on-line pedagogy.

Background: Technology Transitions

The Provost’s charge comes at a time of transition in enterprise information technology. There are currently three major technology shifts that could have enormous implications for higher education:

1. The continuing sophistication and lowering cost of networked communications, even internationally: audio and video conferencing in tandem with shared documents have become cost-effective and convenient enough that¹ they are now a regular part of the operation of many firms. There is often no need for specialized equipment. For many purposes, people can participate in remote meetings using laptop computers and ordinary network connections.
2. The shift toward cloud computing infrastructures: cloud computing being driven by the economies of scale for data centers and support functions. For education, it is now possible to provide media services and interactive computing at global scale, even at modest cost – sometimes even cost-free (for example using YouTube videos).
3. The shift toward mobility, especially away from desktop computers and toward smartphones and pads: Many people, including students, now inhabit a world where they are always connected and where the boundaries between computer-augmented communication and face-to-face meetings have begun to blur. Educational technologists have begun to talk about the possibilities of “everywhere learning”, but the larger implications for residential education have hardly begun to be explored.

Background: Institutional Opportunities

It’s difficult to predict how the three shifts above will play out, even over the short term. But it is apparent that they could provide opportunities for increased flexibility and new ways of teaching

¹ According to an April 2010 study by the Pew Research Center, one out of every three teens in the US was sending more than 100 text messages per day, or 3000 text per month. <http://pewresearch.org/pubs/1572/teens-cell-phones-text-messages>.

and learning in MIT's educational programs. This includes opportunities for students, faculty, departments, and for the Institute as a whole.

Example 1: The increasing variety in forms of preparation among MIT's student population is making it increasingly difficult to design subjects that are appropriate for all students. It is common for a class in an entry-level subject to include absolute beginners as well as students with considerable experience— although typically not enough experience to place out of the subject. Judicious use of on-line exercises could give faculty the flexibility to create paths into the subject appropriate for both kinds of students.²

Example 2: MIT is increasingly experimenting with activities in service education, short-term internships, and entrepreneurial project courses – experiences that may not fit comfortably within the confines of semester calendars and class schedules that must juggle four or five subjects at once. Typically we've dealt with this by scheduling such experiences during IAP, when "classes won't interfere with education." With advances in communication and improved on-line materials, it could become practical for faculty and departments to create subjects that include "expeditions" which take students off-campus for two or three weeks during the semester, while nevertheless allowing those students to continue in some other classes successfully. Going further, departments might wish create distance education offerings for students in the residential program to let them spend a semester in an international exchange or a co-op placement, and still be able to participate (in a modified format) in an MIT on-campus course during that semester.

Example 3: Many members of the MIT community could be effective as tutors and coaches for students working with online interactive materials. Their role as tutors could include checking that students are making regular progress and answering questions, something that can be done in a hour or two each week without interfering with their primary appointment. MIT is almost unique in the range and talent of our academic research staff, and it was part of the genius of UROP to engage them in our educational mission. But we could go much farther: we could provide every MIT student with a personal tutor in each core subject.

Example 4: The strength and uniqueness of MIT's educational program rests on our integration of teaching and research. Given the increasing sophistication of interactive educational materials, we could imagine a transformation where the primary educational role of the faculty would not be lecturing or even, in some instances, course development. Rather, it would be mentoring students in research, with the presentation of standard material increasingly relegated to information technology. That would be a fundamental change in the MIT experience, and a controversial one. But it's a direction that information technology can open to us, if we want to go that way.

MITCET's Perspective

The examples above are not meant to be proposals, or even sketches of proposals. They are only evocative, and painted at a broad level. Nor do they represent the range of CET's discussions this semester. Some other directions are listed below. During our fall deliberations, we also sketched several possible ways to get started, but these were meant only as examples, not real plans. But even in their protean form, the examples here highlight two important points about the way CET is addressing our charge.

² An example here is the use of an online tutor for the Python programming language in 6.01. Students who want to take 6.01 but who do not have prior programming experience are encouraged to use this as a way of "bootstrapping" to get ready for the semester.

First, technology may be the enabler for these initiatives, but it is not the motivator. When the present Educational Technology Council was formed in 1999, and even more so with its predecessor in 1995, the question presented was: What opportunities does information technology (primarily the Internet) provide? In contrast, CET's approach here is to consider possibilities for MIT education and to identify places where technology can lower barriers to initiatives that the Institute would want to do anyway, and to explore steps towards lowering those barriers. In consequence, the initiatives we propose will involve technology, but they are likely to go considerably beyond that. Technology can be an enabler, but the question is whether the MIT community wishes to be enabled. As our plans take shape, we will need extensive consultation with the administration over how, or whether, to pursue certain plans, no matter how "practical" they might be from a technology standpoint.

Second, the directions the CET is discussing are transformative. In its early years, CET was happy to sponsor experiment that empowered individual faculty visionaries to demonstrate advances in individual subjects, with little planning for how these efforts related to the MIT educational experience as a whole. For the present activity, we interpret the Provost's charge as asking us to take a more fundamental look at the possibilities for MIT education, and to focus on initiatives that can have broad scope and applicability across MIT. In consequence, our work must involve considerably more discussion with faculty groups and governing bodies than has been the case with previous CET activities. It will also require alignment with MIT resources and programs devoted to educational innovation and educational transformation, for example, the d'Arbeloff fund and various alumni funds. CET will also need regular consultation with the Administration to make sure that we are on the right track, and that we are exploring directions that both the administration and the faculty will support.

Looking to the spring

It remains CET's goal to be able to launch one or two pilots in fall 2011. This requires that the spring will be a time of active consultation with members of the MIT community, and intense planning. From the preliminary directions we've considered, we would like to identify ones where there is

1. sufficient support from students and faculty, even recognizing that some ideas may be controversial
2. a defensible position that this is a direction MIT would like to pursue, and that technology plays a role in lowering barriers
3. a set of practical plans for how to get started, with a plausible funding path for continuing
4. enthusiasm from the administration, that this is a direction in which it would like to lead

As the very next step, we would like to meet with the Provost to get feedback on our initial list of directions, and to get the administration's sense of which ones could meet the four criteria above.

CET Process during fall 2010

Between September and December 2010, CET engaged in a planning process that focused on understanding the current state of education and education technology at MIT, understanding the local and global elements forcing consideration of change, examining the global landscape, and

identifying opportunities for MIT. CET discussions, focus groups with faculty and students, discussions with other universities as well as site visits, and a literature review provide the basis for the observations and recommendations of this report.³

Input from MacVicar Fellows, CET faculty members and MIT's Undergraduate Officers reinforced the longstanding view that a *large part of an MIT education focuses around faculty interactions with students*. The implication is that any initiative needs to consider carefully the affordances and implications of technology for faculty-student interaction (for example, ensuring faculty are supported in using face-to-face time as effectively as possible). Faculty also suggested that it is important to provide support for the sustainability of widespread innovations while still allowing for individual innovation through "edge cases."^{4 5}

Focus groups with the Undergraduate Assembly, Freshman Advisory Seminar and graduate students echoed the importance of the student-faculty interaction. Several students observed that they valued "*seeing*" *the process of constructing knowledge* (including seeing their professors writing the notes on the board.)^{4 5}

CET also collected and reviewed data from Subject Evaluations, OpenCourseWare evaluation surveys, Stellar data and additional reports.⁶ The CET also reviewed current theories and understanding about learning.

Undergraduate students noted:

- "*Educational technologies are useful if they are thoughtfully/effectively integrated in the curriculum and course delivery.*"
- "*I like the independence of MIT, students can learn how they want to learn, and they can look at what they want.*"

The student and faculty focus groups and discussions reinforced longstanding, core MIT values. Several of the core values are highlighted below.

Opportunities and Scenarios

Moving from the focus groups and data collection, CET explored a set of possible scenarios that would *enhance MIT's curriculum and pedagogy*, that would *transform the MIT education experience* (and provide global leadership), that might help MIT *address enduring challenges or new opportunities* (such as strengthening preparation and participation of underrepresented minorities or expanding international education opportunities).

As a first step in this process the Council reviewed core values that underpin MIT education, specifically, the following [drawing upon the 1998 McKinsey engagement with MIT]:

- Student & Faculty Proximity: MIT's core advantages are its reputation and its ability to bring together world-class students and faculty.

³ E-Learning Wiki, <https://wikis.mit.edu/confluence/display/MITCETHLP/Home+Page>

⁴ MITCET October 2010 Meeting, Slides: <https://wikis.mit.edu/confluence/download/attachments/70196887/MITCET-E-Learning-October+2010.ppt>, <https://wikis.mit.edu/confluence/download/attachments/70196887/MITCET-What+We+Know+About+Learning-October+2010.pptx>

⁵ MIT Faculty and Student Focus Groups: <https://wikis.mit.edu/confluence/display/MITCETHLP/MIT+Focus+Groups>

⁶ MIT Statistics and Survey Data: <https://wikis.mit.edu/confluence/display/MITCETHLP/MIT+Stats+and+Survey+Data>

- Inseparability of education and research: Research and teaching should continue to be linked and synergistic.
- Uniqueness of the MIT community: Intimate student/faculty interactions should be preserved and enhanced.

Through a multi-stage process, CET members identified the following scenarios as being of “high” interest using these criteria: benefit to student learning and programs (especially with respect to residential education), long-term impact on MIT, implementation difficulty, profitability (cost), political feasibility, risk of failure/harm to MIT.^{7 8}

- Learning Styles: Allowing several different styles of learning going through MIT with deeper and more refined contact with individual students.
- Pre-preparation: Making lab time more efficient.
- More Interaction: More personalized interaction with other students and a faculty mentor around learning objectives.
- Global Interaction: Interactive virtual learning environment facilitating global interactions with faculty and students from different universities around the world.
- Dynamic Curriculum: The concept of curriculum shifts from static to dynamic, evolving and personalized built of small chunks.
- Redefine Experience: Putting independent learning and research at the center of the undergraduate experience by increasing the role of self-study and advanced standing examinations for "training" material.

Project Based Learning with Analytics: More project based learning mixing analytic-action-review/reflect learning modes.

Targets of Opportunity for Experiments/Action

Through its discussions and input received, CET recognized that there are opportunities for MIT to enhance and transform education through the considered application of technology. CET believes that we’re not using the full potential of our community and our infrastructure; in some of our teaching we are continuing to place students in an “antiquated” system that does not take full advantage of their potential. Our students are increasingly comfortable in a digital world, and that brings with it a new way of thinking about access to innovation.

The CET, in its discussions, identified the following opportunities which technology could help address

1. opportunities to address the varied set of capabilities of the students
2. opportunities to redefine the model of a semester
3. opportunities to integrate research and teaching more effectively
4. opportunities for more interaction of students with students and students with faculty
5. opportunities for better use of faculty time

⁷ MITCET November 2010 Meeting, Slides:

<https://wikis.mit.edu/confluence/download/attachments/70196887/MITCET-E-Learning-November+2010.ppt>

⁸ MITCET November 2010 Meeting, Notes:

<https://wikis.mit.edu/confluence/download/attachments/69477149/CET+Notes-111910-3.doc>

A theme associated with all of these opportunities is the need for a common infrastructure in order to enable sustainable change. The CET believes that with a relatively small investment, it is possible to do much better both with regards to effective learning by the students and in the use of faculty time.

Through educational technology, MIT could:

- Address the varied abilities (capacity, preparation, interests, motivation) of its students by providing alternative pathways to learning, delivery and resources including leveraging resources elsewhere
- Redefine the model of a semester from being a fixed-time or fixed-content construct to being one in which learning occurs in modules of varying durations with opportunities for varied experiences.
- Move from teaching content alone to providing hands-on and research experiences that utilize the inquisitive and entrepreneurial nature of MIT students and faculty.
- Increase the quantity and quality of interaction between all of MIT's constituents—students, faculty, staff and alumni.

In general both the Oxford model of individualized tutors as well as the Harvard Medical model of student/practitioner-based teaching present useful models to match or excel through the effective use of technology in MIT education. We aspire to build on their better attributes and more- adapting to MIT's culture and future-oriented mission. Thus, overall, we perceive many opportunities for improving various aspects of student learning (e.g., increasing its efficacy).

The CET recognized, however, that any transformation would require a systemic perspective: examining whole Courses, interrelationship between Subjects and Courses, and the technology, support and advising infrastructure.

Why, What, How and Where

The CET spent some time addressing the following questions

1. **Why** should MIT try to bring significant educational technology to bear on the core of the MIT education given that we have an excellent education that supports our core values?
2. **What** should MIT do specifically to produce more of a hybrid education between face-to-face and online?
3. **How** can these changes be implemented in the MIT system in a way that is transformative and sustainable?
4. **Where** should students be able to experience this transformed education?

Why we want to do this is driven by the desire to enhance student learning across the range of students who come to MIT. What we do will include introducing many more tools (such as virtual tutors) and simulations into the education along with self-paced ways of assessment. How we will enable this change is by exploring substantial flexibility in educational delivery so that we move away from a rigid semester model of education. Finally, our MIT students should be

able to learn material in the MIT way (with depth, rigor and substantial faculty/student interaction) from anywhere in the world, so that we enable international experiences.

Specific Opportunities to explore

The following specific programs are seen as presenting potential tangible and substantial targets for exploring and demonstrating transformative opportunities:

1. The Science Core: The CET discussed the possibility of exploring applications of technology to the delivery of the science core (perhaps focusing on Biology and Chemistry, where enrollments present a challenge to our present lecture model) as a follow-on process. The opportunity exists to rethink the science core to increase its modularity in content and flexibility in process/delivery to provide richer learning experiences for our students.

Any transformation in delivering the Science core would also be of interest to other institutions (and potentially present the opportunity to influence the educational practice worldwide)

2. International education and Global Learning Experiences
3. Some of the programmatic recommendations from the Task Force on Undergraduate Education, specifically regarding a Design core or reimagined Lab requirement, present opportunities for technological and curricular innovation to work in tandem; the Communications Intensive requirement, as a sequential process with various pathways and shared outcomes, also presents an appropriate area in which technology could provide a helpful supplement and tools.