Report of the:
Task Force on the Future of Graduate Education in the Context of MITx (TFGEM)

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October 7th, 2013
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Task Force on the Future of Graduate Education in the Context of MITx (TFGEM)

Charge
1. Formulate a strategic vision for the deployment and development of MITx to enhance MIT residential graduate education, both professional masters and doctoral, based on outreach to the MIT community, current literature, and best practices in the field of technology-enabled education
2. Identify and prioritize key areas of opportunity for the use of MITx to improve the quality of graduate education in the areas of graduate administration, finances, resources and personal support, coursework (i.e. recommendations for classes to put on MITx, the development of new classes, collaboration across schools, etc.), research (including supervision of undergraduates), and professional development
3. Develop a product roadmap and recommended technological functionalities for the Edx platform for the priorities identified in 2) and 3)
4. Create rigorous pilots and assessment plans for the priorities identified in 2) and 3)
5. Formulate a set of principles, guidelines, training, expectations, certification, and opportunities for MITx graduate student teaching assistants and consider the implications of MITx on the TA funding model

Membership
- Christine Ortiz, Dean for Graduate Education and Professor of Materials Science and Engineering, Massachusetts Institute of Technology (Chair)
- Derek Jaeger, Senior Program Manager, Learning Management Applications, Information Services and Technology (Staff to Task Force)
- Eran Ben-Joseph, Department Head and Professor, Department of Urban Studies and Planning
- Lori Breslow, Director of the Teaching and Learning Laboratory and Senior Lecturer, Office of the Dean for Undergraduate Education
- Philip Khoury, Associate Provost, Ford International Professor of History
- S. P. Kothari, Deputy Dean and Gordon Y. Billard Professor of Management, Sloan School of Management
- Pavitra Krishnaswamy, Graduate Student Representative, Harvard-MIT Health Sciences & Technology Program
- Vijay Kumar, Director, Office of Educational Innovation and Technology and Senior Associate Dean, Office of the Dean for Undergraduate Education
- Alan V. Oppenheim, Ford Professor of Engineering, Department of Electrical Engineering and Computer Science
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- John Rogosic, Graduate Student Representative, Department of Materials Science and Engineering
- Sara Seager, Professor, Department of Earth, Atmospheric, and Planetary Sciences
Jit Hin Tan, Graduate Student Representative, Sloan School of Management and Chemical Engineering

**Reporting**
The task force will run from February 2013 to May 2013 and report out to the Director of the Office of Digital Learning and Professor of Mechanical Engineering Sanjay Sarma, as well as at the May 2013 Office of Digital Learning Retreat.
Task Force on the Future of Graduate Education in the Context of MITx (TFGEM)

Executive Summary
Residential graduate education, which is intimately entwined with the university research enterprise and mission of MIT, is evolving to include increasingly deeper and more diverse collaborations between individuals, laboratories, universities, and countries – with graduate students becoming ever more intellectually and socially engaged, interactive, and rapidly connected to resources, information, the Institute, the nation, and the world. The TFGEM was charged with formulating a strategic vision and identifying key areas of opportunity for the deployment and development of MITx to enhance the quality of MIT residential graduate education and also providing recommendations for potential pilots and assessments for the identified areas. The TFGEM’s discussions yielded a sentiment that the core of high quality graduate education and research is closely linked to face-to-face interactions with faculty, research groups, and peers, and that residential graduate education should enable graduate students to acquire skills themselves by “learning to learn” and “learning by doing.” Simultaneously, the TFGEM asserts that MITx, and more generally digital technologies, hold many possibilities to enhance graduate education. Three sub-groups were formed and recommended exploration of the following potential initiatives:

Sub-Team #1: Graduate Course and TAs:
a. Define and develop a new category of graduate teaching assistants which have training and increased levels of expertise and proficiency in digitally-based pedagogies, tools, and assessment, in addition to subject matter expertise;
b. Create a clearinghouse for preferred digital technology resources and initiate within the Office of Digital Learning a central mechanism for listing, vetting, rating, reviewing, and exchanging information about best practices (i.e. case studies);
c. Develop graduate-level collaborative, geographically-distributed teaching and learning opportunities which are potentially multi-university, multi-national, and/or interdisciplinary, as well as engage external groups such as alumni, industrial sponsors, etc.

Sub-Team #2: Thesis Research and Co-Curricular Skills:
a. Develop functionality within Edx for graduate student training in 21st century research skills and graduate student professional development;
b. Carry out experiments in publication media and formats: for example develop guidelines for the next generation thesis dissertation, in conjunction with MIT Libraries;
c. Formulate mechanisms for sharing and archival of research progress, such as online laboratory notebooks.

Sub-Team #3: Graduate-Level Assessment and Research in Teaching and Learning:
a. Create opportunities along a spectrum of educational studies for graduate-level pilots employing digital technologies – from assessment to applied research to basic research – that involve a variety of mechanisms such as surveys, interviews/focus groups, performance tasks, and/or data analytics;
b. Develop and disseminate knowledge-based best practices on educational research to the MIT community, for example, by developing a web-based self-assessment module for faculty, instructors, administrators, and students;
c. Choose projects to be assessed according to criteria that will allow for meta-analysis.
Overview

Residential graduate education, which is intimately entwined with the university research enterprise and mission of MIT, is evolving to include increasingly deeper and more diverse collaborations between individuals, laboratories, universities and countries – with graduate students becoming ever more intellectually and socially engaged, interactive, and rapidly connected to resources, information, the Institute, the nation, and the world.

The TFGEM’s discussions yielded the sentiment that the core of high quality graduate education and research is closely linked to face-to-face interactions with faculty, research groups, and peers, and that residential graduate education should enable graduate students to acquire skills themselves by “learning to learn” and “learning by doing.”

Simultaneously, technology has already enhanced graduate education significantly in many ways: consider literature organization software, instrument training webinars, scientific social media platforms, online disciplinary discussion groups, remote experimentation and simulation, virtual scholarly conferences, and open e-print archives – and yet the development and application of these technologies are still in their infancy.

The TFGEM asserts that MITx, and online learning in general, hold many possibilities to enhance graduate education, particularly in the areas of innovation and training for digital learning teaching assistants; professional development of 21st century research and transferable skills; engagement with alumni, external collaborators, and organizations in graduate-level courses and research; development of collaborative, geographically-distributed, multi-university, multinational courses; experiments in new publication media and formats; as well as formulation of mechanisms for early sharing, archival, and discussion of research progress.

Process

Five meetings were held between February 2013 and May 2013. The TFGEM first received a presentation from Professor Ike Chuang, Department of Electrical Engineering and Computer Science and Assistant Director of the MIT Office of Digital Learning, to understand the current state of MITx. The TFGEM then divided into three sub-groups:

1. Graduate Course and TAs (Eran Ben-Joseph, Alan V. Oppenheim (lead), and Jit Han Tan)
2. Thesis Research and Co-curricular Activities (Pavitra Krishnaswamy, Christine Ortiz, Kristala Prather, and Sara Seager (lead))
3. Graduate-Level Assessment and Research in Teaching and Learning (Lori Breslow (lead), Derek Jaeger, and John Rogosic)

The sub-groups worked outside of the scheduled TFGEM meetings, as well as met for a portion of the time during the scheduled TFGEM meetings. They reported out on their progress during the scheduled TFGEM meetings to garner feedback and advice from the full TFGEM. The TFGEM investigated and considered relevant initiatives and resources both within and outside of MIT, and reflected on their own extensive experience with this topic. Outreach to the MIT
community was carried out by individual TFGEM members to their home departments, schools, and selected graduate dormitories via individual interviews, email correspondence and group discussions with faculty, staff, and students. The following initial set of questions was utilized to guide the outreach:

1. Describe any digital technologies used in your graduate teaching, graduate student research, advising, or co-curricular activities that you have found useful.
2. What aspects of the above activities do you feel could be enhanced by digital technologies including but not limited to MITx? How?
3. How do you think graduate education at MIT should evolve in the next two decades, in particular with regard to digital technologies?
4. What external opportunities do you think exist for the development and distribution of MOOCs (Massive Open Online Courses) through MITx?

The outreach to the community was compiled in a master document, distributed to the TFGEM, discussed at the TFGEM meetings, and incorporated into the recommendations. The final TFGEM recommendations were presented at the May 2013 Office of Digital Learning Retreat. This final report was submitted to Sanjay Sarma, the Director of the Office of Digital Learning and Professor of Mechanical Engineering. The TFGEM submitted its report to the co-chairs of the Institute-Wide Task Force on MIT Education commissioned by President L. Rafael Reif for their consideration as well. Lastly, the student members of the TFGEM contributed input to the student survey carried out by the Institute-Wide Task Force on MIT Education.

**Outreach: General Trends**

Outreach to MIT community revealed a number of general trends as follows: 1) Changing attitudes and general openness to digital technologies, with simultaneous emphasis on maintaining quality and faculty-student/student-student face-to-face interactions that are the core of the graduate residential experience, 2) Extensive use of 3rd-party digital technologies to augment course instruction and research, 3) The lack of resources (i.e. time, technical, and financial) to be a significant barrier to progression in the use of digital technologies, 4) Graduate students’ desire for 21st century research and transferable skills, professional development, and more feedback mechanisms on their research and 5) a reduction in barriers to curricular assessment.

**Individual Sub-Group Recommendations**

I. Graduate Courses and Teaching Assistants

Cross-cutting recommendations were initially discussed, such as: reducing barriers for faculty participation by creating opportunities to experiment without the requirement to produce a full online “course” (modular content), as well as accelerating efforts to open-source or open-code the Edx platform. Subsequently, three specialized recommendations emerged, which are described in detail below.
1: The Digital-Learning Teaching Assistant (DL-TA)

Currently, we have a teaching certificate program for graduate students run by the MIT Teaching and Learning Lab (TLL) within the Office of the Dean for Undergraduate Education that includes workshops on student learning, course and syllabus design, lectures, assignments, problem sets and exams, teaching in a multi-cultural classroom, articulating a teaching philosophy, enhancing learning with educational technologies, and videorecording microteaching sessions (http://tll.mit.edu/help/workshop-descriptions). Here, we propose a new category of graduate teaching assistants with increased levels of expertise and proficiency in subject matter, pedagogy, and digital technologies, including the development of an ongoing training program for this category of teaching assistants. The DL-TAs would develop and work with the course instructors to integrate digital technologies into the curriculum, for example: autograding of exercises, collaboration tools, moderate online discussion forums and office hours, data visualization and simulation tools, remote laboratories, course management tools, and mobile devices.

Departments can identify graduate courses to experiment with in utilizing and integrating digital tools for residential teaching. These digital tools would include the development and employment of online resources. In the process of utilizing various forms of digital technology for residential teaching, the role of teaching assistants will change. Low-level TA functions can and should be automated. TA responsibilities and functions are more likely to split into face time, sophisticated online dialog (for example, in overseeing discussion forums), and helping to port course content onto the digital platform. Digital technologies will likely lead to a need for more rather than less sophisticated TAs, and will offer more opportunity for the right experience for the TAs. There will also be an increased need for TAs who are highly motivated and technologically sophisticated. A mechanism will be needed for developing this new category of TA and for training TAs in the use of and best practices with the technology.

Effectively utilizing online resources for graduate courses might well involve different constraints and opportunities than for undergraduate courses and challenges for the course staff, and particularly the TAs. Our graduate population has typically received their undergraduate training in a diverse set of environments. Consequently, in any graduate subject there quite likely will be conceptual, notational, and mechanical differences in the way that foundational material has been experienced. It will become increasingly important and beneficial for the course staff to both develop and have access to online modules for integrating a variety of prior backgrounds into the flow of the course.

Among the key challenges for the DL-TA will be the need for more integrated communication among the DL-TA community. Without this integrated communication, there is the danger of “stove-piping” of preferred resources, with each course developing their experience with their own discovery of resources without the benefit of shared experiences across courses.

Another important challenge for the DL-TA will be developing the skills and experience to manage an effective discussion forum for the course participants. From a variety of discussions,
including the presentations at the ODL Retreat, it is becoming clear that creative and effective use of a well-designed and well-run online class discussion forum can be a major enhancement to any graduate course and to the learning environment. It is likely that this function will become a full-time TA task in many graduate subjects.

At the same time, it is essential that these added responsibilities be recognized as an additional demand on the TA’s time and efforts be made to ensure that sufficient resources be made available (such as having additional TAs to share in the workload).

2: A Clearinghouse for Preferred Digital Technology Resources

Outreach to the community revealed that there are many third-party digital tools that are already being used to augment course instruction and research, many in novel ways (such as the use of Flickr to display and solicit feedback for students’ work in a photography class). On the other hand, there are few avenues to share knowledge and use of such tools. We envision a clearinghouse for such digital technology resources to address this, specifically:

a. Establishing a central mechanism for vetting and reviewing such tools within ODL. Instructors, especially those new to digital learning, have few opportunities to learn about available digital tools that could enhance their courses, and may be reluctant to experiment with new tools that the instructor is unfamiliar with. Having a central mechanism to vet and review such tools would enable them to have a convenient location to find appropriate tools as needs arise, and explore other tools which might potentially be used in their classes.

b. Creating a forum/rating system where users can share experiences of using the tools. In addition to learning about the available digital tools, instructors would benefit from sharing their experiences with the tools in actual use and being able to rate and comment on them. It is envisioned that the comment system could include contexts such as the level of students (undergraduate/graduate), field of study, type of class, number of students, and ratings of the tool by the students (where appropriate) in order to give greater relevance to other instructors. It is here that novel uses beyond what was originally intended by the tool developers could be shared and propagated.

c. Enabling seamless integration of such tools into the digital learning platform where appropriate. With multiple such tools potentially used on a single course, instructors and students would benefit from having a seamless integration of the tools with their digital learning platform where appropriate, such as a single log-in to access all tools. It is recognized, however, that implementing such integration may be challenging.

In addition to making a wide variety of tools available to instructors, establishing such a clearinghouse would also have the positive effect of enhancing the profile and reputation of EdX/MITx amongst such third-party tool developers, hopefully making the EdX/MITx platform a desired partner of the tool developers, with new digital tools being designed with the
platform in mind. Such a clearinghouse has the potential to add to the reputation of the platform, as well as reduce barriers and target both innovation and experimentation, facilitating the move beyond early adopters.

3: Collaborative Residential Distance Teaching and Learning
Specialized advanced graduate courses are particularly amenable to collaborative, interactive teaching. Such courses provide opportunities to link people across geographic locations, professional domains, and work settings anywhere at any time. They could be multi-university, multi-national, and/or multi-disciplinary, as well as based on project clients (e.g. companies, cities, public agencies, and other sponsors). These courses could also provide an excellent link to our alumni, as well as the many postdocs residing on campus.

Distance collaborative teaching and learning have somewhat different technology needs that are richer than the residential local classroom, and are unlike a “flipped” class or a MOOC. Distance collaborative teaching and learning also relate strongly to collaborative research and project execution.

In general there are three different yet intersecting models of collaborative residential distance courses: traditional “flipped” courses, interactive hybrids, and connective studios (Figure 1). These models are suggested in the Venn diagram below. While there are some digital learning technologies that are common to all three, there are significant differences in needs and constraints overall. It should be noted that intersections/relations between the three models should be further explored. These should not be seen as rigid boundaries or specific content driven.
Figure 1. Intersecting models of collaborative residential/distance courses

Traditional “flipped” courses:
Such courses tend to be most suitable for online MOOC-type instruction. In these courses, students may be able to develop background expertise related to prerequisites. Modules developed or available for these background topics would enhance residential courses. Such courses could enhance and fulfill general requirements or provide background on specific topic (e.g. historical developments, scientific underpinnings, etc.).

Interactive hybrid:
These courses provide a possibility for close collaboration between partners while utilizing some of the “flipped” or MOOC type structure. They could provide an integration of online teaching and learning together with a residential component. Potential topics may include more specific specialized topics (e.g. advanced treatment, state of the art topics).

The Connective Studio:
These project-based courses could concentrate on a single multifaceted topic (e.g. energy, water, infrastructure, mobility) that has connected themes of interest across different fields as a focal point to generate modular components either from scratch or extracted from existing classes or
projects. They provide potential connections with clients (sponsors, companies) as well as potential collaborations across schools and disciplines.

Both the interactive hybrid and the connective studio models could provide an impetus for planning and designing MIT’s “classroom” of the future. What would such spaces look like? For example could these spaces be “hackable,” allowing the restructuring of the room based on the mode of teaching, breaking into teams, writing on the walls, and engaging the collaborative technologies through digital interfaces and high visualization?

II. Thesis Research and Co-Curricular Activities
Thesis research and professional development form cornerstones of the residential graduate education experience. Over the last decade, digital tools have substantially revolutionized the process of research – through literature organization software, instrument training webinars, scientific networking platforms, online discussion groups, remote experimentation, virtual conferences, and open access publishing. Here, we consider opportunities to enhance and further channel the influence of digital tools on graduate thesis research and professional development. We summarize our findings around three key recommendations: skill and professional development, experiments in publication, and sharing and archival of research progress.

1: Platform for Research Skills Learning and Professional Development
Discussions with students revealed a desire for training in 21st century research skills (such as big data, computational logic, instrument training, etc.) and in professional development (via modules on topics ranging from interpersonal management skills, creating collaborations, communicating science, writing and presentation skills tailored for digital media, etc.). Furthermore, we learned that students desire more feedback mechanisms beyond their research groups and department – and earlier before publication. Faculty emphasized that high quality thesis research is tied to face to face interactions with faculty, research groups, and peers, and that residential graduate education should enable students to acquire skills themselves by “learning to learn” and “learning by doing.” We also recognized that individual departments do not have resources or expertise to provide courses on these general skills or professional development modules. Thus, steps to enhance residential graduate research and professional development should enable graduate students to share, gain skills, and network with peers and alumni, as well as enable student communication and the branding of their own professional skills and research in ways suited to new media.

Integrating the above findings, the sub-team noted that students would benefit from an avenue to source, generate, and organize content related to research and professional skills. Approaches to help students learn transferable skills beyond what is required for their lab or research projects would be valuable. Further, interaction with the larger community of alumni and scientific or technical experts across universities, industries, government, and non-profit institutions would provide a critical value-add to student thesis research, projects and career preparation.
Thus, we propose the creation of an institutional framework – “MITxGradConnect” – to support graduate student research skills and professional development. Digital tools provide a chance to create such a framework, by offering means to integrate, source, generate, and dynamically update searchable modular content. Further, the online medium offers an immediate access to the community of alumni and external experts (for instance via Infinite Connection and social networking tools), offering opportunities for webinars on career planning topics, options for students to obtain feedback on thesis research, communication or other professional skills (e.g. schedule a practice talk with alumni panel), and using MIT resources to develop lifelong professional networks (e.g. find a mentor and schedule mentoring session). Finally, as students commonly seek these resources on an as-needed basis, the just-in-time nature of the online medium better serves these needs than formal semester-long residential course formats.

In accordance with faculty perspective, we believe that such a framework can promote self-help learning as needed, as well as provide a venue for students to generate content and contribute to others’ learning goals (“learning by doing”). We foresee that this platform can serve not just as a static repository but primarily as a hub for dynamic interactive content that aggregates and shares resources from across labs, departments, schools, and the Institute. Such a platform can enable students to have access to processes, practices, skills, and expertise outside of their research groups in a way made possible only by an Institute-wide and dynamic online community.

Specifically, we foresee that such a platform will involve three kinds of content. First, the platform can include a collection of basic modules – including institutionally generated content on basic research and professional skills organized by topic (e.g. IT skills, IP skills, data and statistical skills, computational skills, communication, etc.) and searchable linking to external and pre-existing internal content in these areas. Second, the platform can enable access to MIT, alumni, and external communities. Interactions with these communities can help all members of the MIT community to develop research communication skills, brand their research and career development goals, and seek out outside expert advisors, mentors, or catalysts on a range of research and career topics. Third, the platform can host webinar-like events on a range of professional development topics (e.g. management and people skills training for collaborative environments), panels and presentations for alumni perspective and feedback, interfacing with industry on emerging trends, workshops on the virtual workplace, how to teach with digital media, and how to manage remote collaborations.

It is our view that any such offerings should not be a formal required curriculum or prescriptive, but rather the philosophy should center around aggregating resources across the Institute. Certification may serve as an incentive. We believe that an investment in such a platform would not only equip graduates with important skills but will benefit MIT’s mission at large by substantially enhancing resource utilization both on and off campus, research output and impact, and marketability of graduates.
With regard to the above recommendations, methods to integrate existing social media, discussion forums, and repository features into the MITx platform would be beneficial. Further, integrating resources to access alumni, outside experts, and other community members, as well as real world information streams into the platform would be valuable. Interactive features are crucial for this platform – to enable one-on-one and multi-person meetings and interactions.

A starting point implementation could be to create some basic modules surrounding big data and/or linking to good internet resources on topics noted above. It would be important for the user interface to enable search and dynamic update functionalities for this content. The current user interface is already equipped with video. Modular and dynamic capabilities to enable users to update and keep the platform interactive, and add-ons like interfacing with Infinite Connection and capabilities for online meetings (fusebox) can enable live discussions and online communities. There is a need to address tensions with IP issues. Integration with commonly used social media can be a future step.

2: Experiments in Publication Media and Formats
There was general interest from both student and faculty to expand the publication format to include evolving media in ways that are most suited to the project being presented. For example, the means to include 3D models when necessary, to create dynamic presentations in interactive formats, or to allow explicit inclusion or referencing of data used in thesis research. Further there was a widespread recognition of the opportunity and need to enable collaborative efforts and enhance publication utility with evolutions in publication media (e.g. through virtual journal clubs or multi-university seminars). Thus, the sub-team felt that reviewing thesis requirements in the context of evolving digital technologies and media formats (e.g. enhanced PDFs), investigating best practices for 21st century knowledge dissemination, developing guidelines for the explicit inclusion of data digitally in thesis publications, and engineering means to integrate publication with discussion would enhance both graduate student thesis research and professional development.

3: Sharing and Archival of Research Progress
In this context, we propose three experiments in communication and knowledge dissemination. First, the variety of graduate student research projects deserve an investigation into how Institute thesis requirements can adapt to the unique needs and media suited to student projects. Second, considering the recent general drive towards open access in digital spaces, the emerging influence of big data, and need for data sharing, we felt that research progress would be substantially enhanced by a medium to share data within the Institute. Finally, to enable post-publication review and peer learning, cultivate cross-field perspective on publications, and enable unique Institute-wide discussions on topics such as translation of methods and best practices between disciplines, we recommend university-wide digital spaces and discussion boards.
Specifically, we propose the development of guidelines for DSpace 2.0 in conjunction with MIT Libraries that can integrate videos, social media, data, and discussion. Further, we propose additional features that will enable sharing of research ideas and questions, virtual journal clubs, and a one-stop means to connect external users to MIT research. The sub-team believes that these experiments in publication media and formats will not only broaden students’ research horizons, but also enable cross-pollination of ideas and potentially accelerate research progress.

On the technical front, the above features will require functionalities for integrating different modes of information presentation, integrating institutional research publications with common literature, and referencing tools. On the policy front, it is important to define copyright issues and how layered access permissions can be used to address copyright and intellectual property concerns.

Implementing these recommendations requires a series of visioning exercises – with ODL, Libraries, MIT TLO, and senior academic policy administrative personnel – on how such a platform may be constructed. Surveying MIT researchers to list virtual research resources and social media tools they currently use seems to be an appropriate starting point of data collection for this effort.

III. Graduate-Level Assessment and Research in Teaching and Learning

Assessment is multifaceted, with applications ranging from determining patterns of usage for a particular online tool to exploring the science behind how people learn. In some sense, assessment can be seen along a spectrum, as illustrated in Figure 2 below. But its overarching goal, as it is most often done in the educational community, is to systematically collect data to determine how well a pedagogical method, curricular design, or technology helps students master knowledge, skills, or habits of mind.

Assessment can be used to determine:
  • What students have learned (outcome)
  • The way they learned (process)
  • Their approach to learning (learning strategy or behavior)

Students can be assessed before in-class instruction or an out-of-class experience to get a baseline of what they know (for example, by administering a pretest). During a class, workshop, or online interaction, assessment can determine what students are learning, so pedagogy can be altered or the experience improved. Quizzes or mud cards, which ask students to identify the “muddiest point” that remains for them after the class or lesson, are two methods of this kind of “formative assessment.”
After an educational experience is completed, assessment can help determine if there has been a change in knowledge (final exams can be used for this kind of “summative assessment”) and provide information to revise the class, program, platform, etc.

Assessments can take the form of simple surveys of user behavior, interviews or focus groups, pre- and post-testing of content or attitudes, or more carefully designed experiments with specific hypotheses and control groups. Ultimately, the method and quality of assessment depends on the particular initiative being assessed, the needs of the stakeholders, and the resources available. Studies of usability and use/adoption patterns are likely to generate simple quantitative results; research into the impact of an intervention on learning, which is often of the greatest interest, is generally more difficult to implement.

While the same methodologies are often used for undergraduate and graduate studies, graduate studies may involve smaller sample sizes, focus on an entire program rather than a course, and rely heavily on unstructured interviews to probe the experience. Interviews of graduate students can be longer and more comprehensive, explore more deeply, and usually pose more challenges to construct a viable, cohesive picture of a cohort.

In order to aid the work of the TFGEM, the subgroup on assessment took two examples of online tools that, if developed, could contribute to the education of graduate students and show how they might be evaluated.

![Figure 2: Spectrum of Educational Studies from Assessment to Basic Research](image)

1: *Modules to train students in the use of experimental equipment*

These modules are envisioned as a multi-departmental initiative that would aid in the transfer of knowledge and skills typically not associated with learning that occurs in the classroom. Currently, most departments/centers having a training model in which users attend a lecture-like PowerPoint session or conduct an independent review of readings, followed by hands-on equipment training.
The potential to digitize some of the “lecture/background” content in such cases could result in long-term savings of person-hours, allowing for more time to be spent in hands-on training. Furthermore, the addition of interactivity to the independent preparation time could improve retention. Essentially, all the same arguments for a blended learning model in the classroom apply to this kind of tool.

Assessing the effectiveness of these modules might involve: measuring the time savings on the part of staff over the long-term adoption of digitized content, comparing both performance and confidence during the hands-on component of the training session, and evaluating retention by performing A/B testing between online and face-to-face training sessions by administering post-training questionnaires after a period of time. Figure 3 below summarizes these assessment options.

<table>
<thead>
<tr>
<th>Category</th>
<th>What Is to be Assessed</th>
<th>Survey</th>
<th>Interviews, Focus Groups</th>
<th>Performance Tasks</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>Who is using the modules?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usability</td>
<td>How easy are the modules to use?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>When and how are students using the modules? Do they prefer them to on-site training? Do the modules save them time and effort?</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact</td>
<td>Do students who access the modules use equipment more expertly than those who were trained on site?</td>
<td>✓ (both after training and long term)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3: Summary of assessment for online training modules

2: “Match making” skills and knowledge of graduate students from diverse disciplines
A graduate student may need a specialized kind of knowledge or skill that is important, but not central, to his/her research. However, this information or capability may be the focus of other graduate students’ work at MIT, and they would be happy to share their expertise. While there
are other sources for this information (scholars at other universities, online resources), it would be simpler and more productive if graduate students at the Institute could meet and share knowledge with one another.

We envision, therefore, a “matching” website where students could request to meet others with a specific background and/or where students could list the skills and expertise they have and would be willing to share. Besides the obvious community-building advantages, facilitating the “introduction” of graduate students to one another could be fertile ground for future research collaboration.

Assessing the effectiveness of this tool would be similar to the process we outlined in Figure 3. That assessment might involve gathering data on who is using the website, determining the purposes for which it is being used, evaluating user satisfaction, and judging the impact on time savings, future collaborations, and community building. Figure 4 below summarizes these assessment options.

<table>
<thead>
<tr>
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<th>What Is to be Assessed</th>
<th>Survey</th>
<th>Interviews, Focus Groups</th>
<th>Performance Tasks</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>Who is using the website: department, gender, topic of research, etc.?</td>
<td></td>
<td></td>
<td></td>
<td>Instrumentation of website for data collection and analysis</td>
</tr>
<tr>
<td>Usability</td>
<td>How effective is the organization and format of the website?</td>
<td></td>
<td></td>
<td></td>
<td>Usability studies through observation &amp; interviews</td>
</tr>
<tr>
<td>Use</td>
<td>What is the utility to users: what resources are being accessed? ✓ ✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact</td>
<td>What is the impact of the website: knowledge transfer, community building, interdisciplinary research projects, etc.? ✓ ✓</td>
<td></td>
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</tr>
</tbody>
</table>

**Figure 4:** Summary of assessment for website to match graduate students’ knowledge and skills

The subgroup on assessment of TFGEM makes the following recommendations for assessment as part of the effort to improve graduate education at MIT through the use of digital tools and content: Develop and disseminate knowledge-based/best practices on assessment and educational research to the MIT community. This could be accomplished, for example, by:
a. Developing a web-based assessment module for faculty, instructors, administrators, and students
b. Designing and implementing workshops for those constituencies
c. Raising awareness of material that already exists on the Teaching and Learning Laboratory website
d. Choosing projects to be assessed according to criteria that will allow for meta-analysis. This recommendation stems from the assumption that resources will not be available to assess every project. Therefore, we recommend that criteria be specified in order to select a category of project to be studied, as, for example, initiatives related to improving graduate students’ professional skills.