Factors Affecting the Adoption of Faculty-Developed Academic Software:

A Study of Five iCampus Projects

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Teaching, Learning, and Technology
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Executive Summary[1] of Findings and Recommendations

Stephen C. Ehrmann, Steven W. Gilbert, and Flora McMartin, The TLT Group

"Initiated in 1999, iCampus is a research collaboration between Microsoft Research and MIT whose goal is to create and demonstrate technologies with the potential for revolutionary change throughout the university curriculum."[2] The program was made possible by a $25 million research grant from Microsoft to MIT, and involves extensive collaboration between MIT and Microsoft staff.

The TLT Group has been asked, "In light of the experience of iCampus, especially those projects selected by MIT and Microsoft for close study, what can be learned about priorities for educational technology initiatives in the future and about how the spread of such innovations can be more effectively supported?"

In the past many large-scale faculty-developed content-specific projects had had great success as pilot tests, but had failed to be widely used. So The TLT Group and iCampus decided to focus this study on five quite different projects that had already achieved some degree of institutionalization and wider use. Over 150 interviews were conducted with faculty members, staff and students at MIT and other institutions, and project documents were studied. The five projects are:

- iLabs – students can use web browsers to design experiments and collect data from distant laboratory equipment;
- iMOAT – the web is used to manage the process of large-scale assessment of student writing;
- TEAL – two terms of introductory physics have been redesigned around inquiry, discussion, experimentation, and visualization;
- XMAS – students can 'quote' video legally in their online discussions, presentations, and projects about films in courses such as Shakespeare
- xTutor is to be a tool kit for creating online courses; its strength is checking computer programming homework and providing feedback.

We have concluded that:

A. These five projects have improved important elements of an MIT education by making learning more authentic, active, collaborative, and feedback-rich. For example, they have been institutionalized in a two-term physics sequence required of most MIT students, three of the four core courses required by MIT's largest undergraduate major, and in the writing assessment used for incoming MIT students. For all five projects, ideas and materials have also been adopted by additional faculty at MIT and by faculty at other institutions. These adoptions, along with evaluative evidence, demonstrate the value of these projects.

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[1] The URL for the Executive Summary can be found at http://icampus.mit.edu/reports/exec_sum_icampus_assessment.pdf and on http://www.tlgroup.org/iCampus/exec_sum_icampus_assessment.pdf. The full report will be available from the http://icampus.mit.edu/reports/ and http://www.tltgroup.org/iCampus/ websites by January 2007.

[2] From the iCampus web site, http://icampus.mit.edu , November 10, 2006

B. Nonetheless, wider adoption has been extremely difficult to promote, despite the fact that the materials are free and that over $2.5 million has been allocated for outreach. Because there is little incentive or support at most institutions to seek out and adopt innovations from other institutions, the burden falls almost entirely on the innovator and iCampus to seek out, persuade, and assist the innovator's peers to use the innovations. This was made even more difficult by gaps in communications channels as well as a lack of supports and incentives at both ends of the adoption channel.

C. Adoptions did occur, however. They were aided, first, by certain project features (e.g., the ability to try out software freely over the Web; development procedures that engaged potential adopters from the start).

D. Second, adoption was easier when innovators could take advantage of existing 'coalitions for instructional improvement' to attract the attention of potential adopters without seeming to tell them how to teach, and then assist them with adoption.

E. Third, adoption was easier when the adopting institution was unusually motivated to adopt iCampus innovations and then to disseminate them further. Distance seemed to help institutions work with MIT; many of these motivated institutions were in other countries.

Innovations rarely prosper for long at any one institution unless they also spread among many institutions; if wide use is achieved, the various users can support each other and long term survival of the innovation is far more likely. So widespread adoption for expensive R&D projects is a virtual necessity for getting full value for the original investment..

Our full report contains actionable recommendations for universities, government funding programs and foundations, and corporations. This executive summary includes only the headings of those recommendations. Our first recommendation draws on Finding A and on wider experiences in the field:

1. Improve education widely so that it becomes more authentic, active, collaborative, and feedback-rich. iCampus software and ideas provide useful elements for such a campaign.

Selected specific sector recommendations for implementation include:

> 1.1.*5 Colleges and universities:* Academic computing, the teaching & learning center, distance learning, the library and any other units responsible for professional development and course improvement should coordinate and organize their collective efforts around these goals.
>
> 1.2.2 *Government/Foundations:* Support development of appropriate methods for assessing these teaching/learning activities and outcomes in the disciplines.
>
> 1.4.2 *MIT specific:* MIT should systematically review all educational innovations supported with major grants from sources such as iCampus in order to determine which deserve internal support for wider deployment or further development.
>
> *(See pp. 107-110 for complete discussion of Recommendation 1)*

As described in our findings, however, it has been difficult for higher education to make such improvements and to respond to societal needs and technological change, because it is so difficult for ideas and materials to spread and evolve through use across many institutions. Therefore, to encourage and assist faculty not only to create innovations but also to search widely for innovations to adopt, we make these additional recommendations.

2. Create demand for adoption of new ideas by rewarding faculty members for continually and cumulatively improving teaching in their programs. Selected specific sector recommendations to implement this general statement include:

2.1.1 *Colleges and universities:* Assist and reward all faculty members who discover, adapt and share practices and findings from other institutions as part of the process of improving their academic programs.

2.1.4 *Colleges and universities:* Specialists, such as reference librarians, staff in information technology, and staff in teaching and learning centers, should work together to help faculty seek out relevant ideas and materials in their disciplines

2.2.1 *Government/Foundations:* Explore ways of providing faculty development opportunities in which *all* interested instructors nationally can participate.

2.3.1 *Corporations:* When funding faculty to apply new technology to educational problems, insist their proposals build on relevant improvements from other institutions, especially developments in their own disciplines.

2.4.1 *MIT-specific:* Requests for discretionary funding for faculty to improve their teaching should be assessed against best practices worldwide.

(see pgs. 112-114 for complete recommendations)

3. **Nurture coalitions for instructional improvement, within and across institutions, in order to create better channels for sharing and improving innovations**.

Selected specific sector recommendations to implement this general statement include:

3.1.1 *Colleges and universities:* Develop and improve ways in which faculty members and students routinely discuss improvements in courses in their disciplines, within and across institutions.

3.2.*1 Government/Foundations:* Fund well-staffed, long-term, content-specific coalitions with the responsibility for reaching out to all faculty members nationally who teach that course or small group of courses.

3.3.2 *Corporations* should investigate the feasibility of a service to help faculty members who teach comparable courses to share information on how they teach and assess, share materials, and even collaborate in teaching.

3.4.1 *MIT-specific:* Study how various departments teach multi-section courses, and the impact of various teaching practices on the testing and sharing of ideas for teaching the course.

(see pgs. 114-116 for complete recommendations)

4. **Create more higher education-corporate alliances in order to support the development and dissemination of new educational technology materials and practices.** Selected specific sector recommendations to implement this general statement include:

4.1.1 *Colleges and universities:* Host corporate staff on campus to help make the alliance work.

4.2.1 Government/Foundations: Fund more R&D projects with higher education and corporate partners

4.3.2 *Corporations:* Fund more collaborative R&D projects that involve faculty at multiple institutions working with corporate staff.

4.3.3 *Corporations:* Take responsibility for promoting adoption of ideas and materials emerging from the collaboration by allocating corporate staff and budget to the task.

(see pgs. 116-120 for complete recommendations)

5. **Supply faculty innovators with central services in educational design, software development, assessment methods, formative evaluation, and/or in sharing ideas with others who teach comparable courses**. Selected specific sector recommendations to implement this general statement include:

5.1.5 *Colleges and universities:* Provide dissemination/adoption support for innovative ideas and materials.

5.2.1 *Government/Foundations:* Insist that faculty developing innovative uses of technology get all the kinds of help they need: educational design, programming, assessment, program evaluation, and dissemination; budget funds for these services where necessary.

5.3.2 *MIT specific:* Provide more support for units that can provide innovative faculty with assistance in educational design, programming, assessment, program evaluation, and dissemination. . *(see pgs. 120-124 for complete recommendations)*

iCampus explored these themes, demonstrating some new possibilities, techniques, and materials. We recommend that universities and colleges, in collaboration with foundations, government agencies, and corporations, campaign to make such improvements, gradually and cumulatively. If these improvements can be institutionalized, substantial improvements in outcomes ought to be possible, e.g., improving the ability of graduating students to apply concepts to unfamiliar problems.

Recommendations such as this can sound trite, because so many people and reports have made them already and because so little has apparently happened. The bulk of the following recommendations describe recommendations for how to implement improvements such as these.

1. 1 Colleges and Universities – Implementing Recommendation 1

1.1.1 **Decide, at the institutional and programmatic level, whether and how to implement this recommendation; include other stakeholders in the discussion**.

Changes of this magnitude are the responsibility of the faculty at most universities, and little is likely to happen at most universities and colleges without their commitment and enthusiasm. But, while faculty leadership is essential, faculty members are not by themselves able to implement such changes. Planning efforts must also include the many other stakeholders whose active participation is essential (e.g., chief academic officer, library, teaching & learning center, academic computing, facilities and space planning, representatives from employers and graduate schools to which graduates often go next, development office, legislative affairs, alumni, and others.)

1.1.2 Give **preference in hiring to faculty candidates with a demonstrated preference for, and skill in, these types of teaching.**

The emphasis here is on authentic, active, collaborative and feedback-rich, not on technology per se. It's easier to train a faculty member committed to active learning how to use technology to move further in that direction than it is to persuade a faculty member who is adept with a technology (e.g., giving PowerPoint lectures to large numbers of silent, note-taking students) to change his or her pedagogical aims to emphasize discussion and problem-solving.

1.1.3 Grant **release time for major course improvements**, with preference to faculty who work together on the same course, or sequences of courses.

While most improvements must be done without release time, which is to say that they will involve relatively small, low-risk, low cost improvements (see Recommendation 5.1.1 on 'low threshold improvements[74]), changes of this sort also require rethinking course designs. And that will often require periodic release time or comparable forms of special support.

1.1.4 **Use these goals as criteria for investing discretionary funds in curricular development, new technology, space renovation, and other purposes, and as themes for soliciting funds from alumni, legislatures, foundations, and other sources**.

1.1.5 **Academic computing, the teaching & learning center, distance learning, the library and any other units responsible for professional development and course improvement should coordinate and organize their collective efforts around these goals**.

These will not be the only organizing goals for these units, of course, but it's important that these units work in a coordinated way to promote this kind of progress.

[74] For more on 'low threshold' improvements, see Recommendation 5.1.1.

1.1.6 **Develop and maintain assessment procedures to guide progress on these goals within academic programs**.

Regular surveys of how students learn and how faculty teach can provide useful guidance about where progress is occurring. Such evidence can also be used to decide where additional resources are needed and to help justify appeals for more resources from benefactors and from government. In the United States, the National Survey of Student Engagement (NSSE) and the Community College Survey of Student Engagement (CCSSE) provide useful contributions to this evidence.[75]

Such surveys should be complemented with other kinds of evidence, including student work, criteria used in grading student assignments, videos of classroom work, interviews, focus groups, and data drawn from learning management systems.

When archiving data on teaching/learning activities in academic programs, use these four themes (authentic, active, collaborative, and feedback-rich) as indexing terms to make it easier for faculty and staff to find examples of current progress.

1.2 Government Agencies and Foundations – Implementing Recommendation 1

1.2.1 **Support model campaigns for curricular improvement within institutions**.

A campaign to create education that is more authentic, active, collaborative and feedback-rich using technology needs to succeed first in a constellation of model programs and universities. These lighthouse programs can demonstrate strategies for supporting and documenting such improvements. Note: the temptation might be to wait until some new technology has appeared, or is in wide use. That would be a mistake. Technologies never stop changing. The right time to start an education/technology campaign is always 'now.'

1.2.2 **Support development of appropriate methods for assessing these teaching/learning activities and outcomes in the disciplines**.

As the TEAL case study has described, Hestenes and Halloun's development of the Force Concept Inventory (FCI) helped trigger and guide an extensive program of improvement in physics education. That's because the FCI combines several distinctive features:

1. Mainstream physicists quickly understand that this is a good way to measure conceptual learning by their students, but
2. They are then usually surprised by how poorly their students, even their good students to. The assessment has revealed that student scores on traditional tests and homework were more tests of memorization and mathematical routine than of physics understanding.
3. The FCI is also capable of measuring improvements that innovations have caused. This is because of two complementary facts:
    - Pioneering faculty members have indeed developed ways of improving students' understanding of concepts, and
    - The FCI is sensitive enough to detect those gains.

[75] For more on the National Survey of Student Engagement (NSSE), see http://nsse.iub.edu/index.cfm. For more on the Community College Survey of Student Engagement, see http://www.ccsse.org/.

Put those features together and you have a tool that can provide impetus for local initiatives and guidance for improving those efforts, based both on local data and on data collected by others using the same assessment tool.

It's not news that we need more tools like the FCI. These tools will likely be discipline specific and may often focus on the kinds of learning that can be most enhanced by appropriate kinds of authentic, active, collaborative and feedback-rich learning.

1.2.3 **Continue to support exploratory R&D**.

Many of these recommendations deal with implementation of reforms such as those pioneered by iCampus. But it is also important to continue to support a range of more exploratory projects that are designed as proofs of concept, to expand our imagination of what is possible. In funding such projects, several criteria should be kept in mind:

- We have some ability to predict the availability and costs of hardware and software in the future, if only by looking at comparable technology in the past. Exploratory projects that use projects relying on affordable reliable technology are less risky than projects that simultaneously explore cutting edge technology and cutting edge education. It only rarely makes sense to fund educational experiments that are based on technology that, three years after funding, will still be too expensive or unreliable for wide deployment.
- As this report has detailed, there is little reason to think that ideas pioneered by projects such as these will spread on their own. Only a limited audience will notice or remember what these projects accomplish unless substantial support for widespread adoption is also supported.

1.2.4 **When considering new proposals for funding, recognize that, even at the proposal stage, it is possible to assess how adoptable the ultimate product or idea might be**.

The Findings section of this report lists characteristics that could be used as partial criteria for funding when wide adoption is a program goal. To summarize them:

- Value, or at least legitimacy, sufficient for all the stakeholders needed to implement the innovation and sustain it, e.g., faculty, IT support staff, institutional leaders in some cases, faculty development program.
- Recognizability: Idea is already in wide discussion so potential adopters can easily recognize the specific innovation.
- Incremental adoption possible: Can be adopted in ways that initially affect only a small part of a course or process so that it be used with rewarding results but manageable investment and risk by someone not yet convinced of the value of the innovation.
- Flexibility and multiple uses so that more innovators are likely to find (or even invent) a use that then deeply engages them.
- Affordability; Time-saving for faculty, or at least not too time-consuming.
- Ease of use for faculty, students, and support staff.
- Few collaborators required.
- The ability of undergraduates to play a role in developing or adopting the innovation, both to help faculty and to demonstrate that implementation is feasible.

1.3 Corporations – Implementing Recommendation 1

1.3.1 **Support education/technology campaigns** with money, corporate staff collaborating with university staff, dissemination support through marketing.

Corporations have much at stake here: the abilities of the people corporations hire from college depends to a significant degree on whether their education is authentic (e.g., dealing directly with the kinds of issues that graduates will face later on), active, collaborative and feedback rich. The better job colleges do, the better off are the corporations who hire their graduates.

Other recommendations below contain more specific suggestions for roles corporations can play in contributing to the success of campaigns to use technology to foster learning that is more authentic, active, collaborative and feedback-rich.

1.4 Additional Implementation Recommendations Specifically for MIT

As we mentioned above, these recommendations are meant as additional, more specific notes to complement the section above which is addressed to universities and colleges.

1.4.1 **Move forward with these five projects**.

By "moving forward," we mean two things. **First, continue to apply innovative and inquiring thinking to their further development. Second, consider each of them as part of wider patterns of improvement at the Institute**. For example, TEAL and iLabs should be seen as parts of a larger pattern of improvement in how experimentation figures in science learning at the Institute. XMAS should be seen one of many tools for enabling more active and collaborative use of visual resources. xTutor should be seen as a mechanism for increasing feedback among faculty and students. Many of the remaining recommendations deal with how to design such campaigns to improve education at MIT.

1.4.2 **MIT should systematically review all educational innovations supported with major grants from sources such as iCampus in order to determine which deserve internal support for wider deployment or further development**.

We have not studied the other iCampus projects, or other projects of this type done with other sources of funds. But we have seen enough to believe there is a risk that some projects of great potential value to the Institute and the wider educational community may simply wither due to lack of internal attention and support. This kind of review will require significant staff time and some use of external review to make sure that the evaluation of each project includes attention to good practices elsewhere.

Recommendation 2. Create demand to adopt ideas and materials from other sources by encouraging all faculty members to improve and document learning in their programs,[76] year after year.

To survive, and to fulfill their missions, universities need to adapt far more rapidly to changes in social needs, student demands, disciplinary progress, and a variety of other pressures and opportunities. As we have seen, a variety of internal factors make that kind of rapid adaptation extremely difficult.

This recommendation focuses on one fact: the academic program cannot adapt rapidly unless academic staff import and adapt ideas, materials and insights: no institution can develop everything it needs internally, and no institution is so unique that it must do so.

Today, however, "not invented here" remains the norm. In 1990, one of the authors oversaw a grant competition at The Annenberg/CPB Projects. Over 10% of all institutions in the United States submitted proposals to create online degree programs and, in citing their track records, most of them asserted that 'so far as we know, we are the only ones doing this.' Isolation and inventing one's own wheel allows the illusion of being first. But it is a slow and wasteful way to adapt.

In research, the best researchers are those most aware of advances all over the world in their fields. They draw on the tools, insights, and failures of their colleagues because they know that importing is essential to success. **The same mentality is needed in education: the best teachers should continually search new educational insights, tools and materials in their disciplines, and selectively adapt them in order to improve their own academic programs**.

This increased pace of improvement in academic programs is necessary not just to attract students and educate all of them in an effective and up-to-date way in their fields, but also educate enough people to help us meet a staggering array of changing needs – economic development, rapid changes in digital technology, terrorism, global warming...

Yet few institutions provide much help for typical faculty members to learn about new findings in educational research, new developments in teaching their disciplines, and new developments in educational technology within their disciplines. Nor do many institutions reward, support, or press faculty members to continually update and improve their academic programs.

The Findings section discussed how this lack of 'pull' for new ideas shifts all the responsibility for dissemination onto innovators who must push their ideas outward, finding and persuading pre-occupied colleagues.

Widespread dissemination and adoption of new teaching ideas is nearly impossible unless there is widespread demand: potential adopters who are in 'search mode,' continually seeking new ideas and materials. Therefore we recommend that colleges and universities find ways to reward and support faculty who persistently update, improve and document learning in their programs.

Barriers to implementation: There are many reasons why few institutions currently reward faculty who make continual, documented improvements in learning in their programs. Only a relatively

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[76] "Programs": we chose this word to emphasize the importance of collaboration among instructors to improve degree programs (courses of study) and to evaluate those improvements. The goal ultimately is to enhance the education that graduates receive and the course of study can be the best level on which to act. Innovations that may seem promising at the assignment level may produce no perceptible impact on the typical graduate. And significant improvements in the skills of graduates may stem from pervasive, cumulative changes that, at the level of individual assignments, may seem quite modest.

few faculty members in the United States have received even a brief education in thinking about teaching and assessment. As a faculty member remarked to one of the authors of this report some years ago, 'I'd like to keep a journal about my teaching so I can see, over the years, whether I'm changing what I do. But I don't have the language to describe what I'm doing as a teacher.' Another interviewee pointed out that, of all the professions, only university faculty members are under no pressure or requirement to engage in professional development in order to maintain their status.[77]

Despite the difficulties, several factors make this recommendation imperative. Pressures on universities and colleges are mounting, and with them insistence from stakeholders that institutions and their faculty be able to describe how their students are learning. And changes in technology, the disciplines and society are turbulent and rapid: in many fields, approaches to teaching that worked well a decade ago are no longer adequate. The half life of teaching materials and approaches is shrinking. It is impossible that individual faculty will each invent all the new ideas and materials they need. So the reward and support system must help them reallocate time so that faculty members spend more time searching for, adapting and assessing new ideas and materials.

2.1 Universities – Implementing Recommendation 2

2.1.1 **Assist and reward *all* faculty members who discover, adapt and share practices and findings from other institutions as part of the process of improving their academic programs.**

The goals of this report are most likely to be implemented if all instructional staff at all institutions are challenged and supported to improve their teaching continually, in part by importing and adapting the best ideas and materials from around the world. To accomplish this, the institution needs to demonstrate the feasibility of continual improvement. The kind of improvement needed must be both a) cumulative and meaningful over a period of years, b) possible within the normal life of mainstream faculty members. The former means focusing in large part on improvements that are, individually, low threshold but that, over time, add up to major change. The latter means that institutions need to provide much more support for teaching improvement. Recommendation 5 in this report returns to this issue in more detail.

2.1.2 **Alter procedures and criteria for hiring, promotion and tenure** in order to find and support faculty members who will continually import ideas as part of their effort to improve and evaluate their teaching.

When hiring new faculty, examine whether the candidates have continually documented and improved their teaching, and whether they are knowledgeable about good practices and relevant research from other institutions.

[77] In the United Kingdom (and perhaps elsewhere), this is beginning to change. See the next footnote on the Higher Education Academy. In the United States, there seems to be some movement toward increased assessment of the quality of university education via surveys, tests, portfolios and other means. This could, in the long run, increase the pressure on institutions to support and reward departments and faculty who continually improve their programs.

2.1.3 **Discretionary funding programs should challenge and support faculty to adopt best practices from around the world**.

Instead of making discretionary grants for course improvements to faculty members that are based on solely on personal enthusiasm and creativity, the institution ought to also require and assist faculty to discover what others have already done. Their course improvements ought to be based on that prior work.

This is especially important, and especially difficult, in educational technology in the disciplines. Educational technology applications are fed by three fields: education (including learning theories instructional design, and assessment, for example), the discipline to which the technology is to be applied (disciplinary advances and applications), and technology (e.g., theory and practice of web services, for example). These three streams come together to form a fourth (e.g., previous achievements in creating remotely controlled laboratories and simulations for educational purposes). Any significant investment in course or program improvement using technology ought to draw on good practices and findings in all four of those areas.

Few faculty members have the time to keep up on all four fronts. The result, too often, are wasteful: reinventing the horse-drawn carriage when a few other institutions have already progressed to making automobiles.

2.1.3 **Specialists, such as reference librarians, staff in information technology, and staff in teaching and learning centers, should work together to help faculty seek out relevant ideas and materials in their disciplines**.

All these groups, including the faculty, need to reach out in order to work together. They will need to coordinate their limited time and travel budgets, discipline by discipline, in order to learn about advances around the world, and select those most appropriate for each academic program and course.

2.1.4 **Regional and professional accreditors should evaluate institutional and departmental track records for importing and incorporating ideas and practices into the teaching, across the curriculum**.

Accreditors should suggest methods that institutions can use to study their own performance, and develop criteria or rubrics that visiting teams can use.

Don't set the bar so high at the beginning that no one can meet it. Remember the goal: to help the institution and its degree programs improve more rapidly in response to changing needs and disciplinary progress. No faculty member, and no institution, can invent or discover more than a tiny fraction of the ideas and practices needed to adapt and excel. So the rate of importing new ideas, as well as creating better practices internally, needs to become much higher. This can only happen slowly but it must happen cumulatively.

2.2 Government Agencies and Foundations – Implementing Recommendation 2

2.2.1 **Explore ways of providing faculty development opportunities in which *all* interested instructors nationally can participate.**

The United Kingdom now has a Higher Education Academy that supports and accredits continuing professional education for faculty members in all disciplines, and certifies faculty who meet certain qualifications.[78] The aim is, over time, for British faculty to have expertise in

[78] For more on the Higher Education Academy, see http://www.heacademy.ac.uk/.

Chapter 10: Recommendations for Fostering Future Improvements in Education with Technology

The TLT Group has been asked, "In light of the experience of iCampus, especially projects selected by MIT and Microsoft for close study, what can be learned about priorities for educational technology initiatives in the future and about how the spread of such innovations can be more effectively supported?"

Drawing on our study of these five projects and on experience, we make five recommendations. The first deals with the kind of educational change whose feasibility has been illustrated by these five projects. The remaining four are strategies to overcome the enormous difficulties of disseminating and adopting such improvements. Stated briefly, the five recommendations are:

1. Improve education by making it more authentic, active, collaborative, and feedback rich. iCampus software and ideas can provide useful elements for such a campaign.
2. Create demand to adopt ideas and materials from other sources by encouraging all faculty members to improve and document learning in their programs.
3. Nurture coalitions for instructional improvement, within and across institutions, in order to create better channels for sharing and improving innovations.
4. Create more higher education-corporate alliances in order to support the development and dissemination of new educational technology materials and practices.
5. Supply faculty innovators with help in educational design, software development, assessment methods, formative evaluation, and/or in sharing ideas with others in their disciplines who teach comparable courses.

We believe that these recommendations will be more feasible if there is substantial collaboration among universities and colleges, foundations and government agencies, and corporations. Therefore discussion of each of these five recommendations begins with a general description, followed by actionable recommendations for universities, for foundations and government agencies that support innovative work in education, for corporations and, finally, for MIT. The MIT recommendations supplement the university recommendations, with suggestions specific to the Institute.

Recommendation 1. Improve education by making it more authentic, active, collaborative, and feedback-rich. iCampus software and ideas can provide useful elements for such a campaign.

There is, and has long been, widespread agreement that many elements of higher education should be:

- more *authentic* (in some ways bear a closer resemblance to the tasks and problems of life after college),
- more *active* (engage students' attention, energy, and creativity),
- more *collaborative* (students thinking and learning together), and
- more *feedback-rich* (students learning by getting rapid results from and/or assessment of work they have done).

teaching as well as in their disciplines. It is beyond the scope of this report to make a specific recommendation of this type, but it seems to us that there is clear reason for foundations, accreditors, disciplinary associations, and others to consider whether an appropriate infrastructure can be supported in the United States and in other countries to help faculty, discipline by discipline, improve as teachers. One major goal of such an infrastructure would be to help faculty with the huge task of keeping up with developments and innovations in their disciplines, in education, and in applications of educational technology in their disciplines. Universities and colleges can often do an adequate job of helping faculty with relatively generic technologies (e.g., using their local learning management system) but they can rarely adequately assist faculty at the disciplinary level.

2.2.2 **Provide grants to help faculty and departments adopt and adapt promising new practices for teaching in their disciplines**.

Support online workshops, train-the-trainer strategies, and other methods to reach out to all interested faculty members who teach the relevant courses.

2.3 Corporations – Implementing Recommendation 2

2.3.1 **When funding faculty to apply new technology to educational problems, insist their proposals build on relevant improvements from other institutions, especially developments in their own disciplines.**

Use reviewers who are expert in these fields to help decide which proposals to fund and, where possible, assist interested faculty in learning about relevant developments in education, technology and their disciplines.

2.4 Additional Recommendations Specifically for MIT

2.4.1 **Requests for discretionary funding for faculty to improve their teaching should be assessed against best practices worldwide**.

Future programs analogous to iCampus and the d'Arbeloff Fund, as well as smaller grant programs, should assist and require interested faculty to base their own proposals on previous progress in relevant fields. Such programs should also use expert reviewers from outside the institution to aid in funding decisions, especially on projects of this size. Reviewers should have varied expertise: educational research, educational technology, best practices in the discipline and, for program such as iCampus, strategies for promoting widespread adoption.

For MIT to be a world leader in educational technology, interested faculty must build on relevant findings and achievements in educational research, technology, and educational technology in their disciplines. We sometimes got the impression that some MIT staff and faculty believe that the Institute was so unusual that, if faculty developed projects that fit their own needs, those projects would therefore be of international significance. But MIT is not unique. To best serve MIT students, improvements must draw upon, and improve upon, best practices in the world.

Recommendation 3. Nurture coalitions for instructional improvement, within and across institutions.

Whether potential adopters are actively searching for innovations or not, it helps innovations spread when innovators and potential adopters already routinely talk about instructional improvements in their disciplines. Finding D in the previous chapter discussed how different such coalitions can be. Based on our study, it appears that a) there aren't nearly enough such coalitions, b) too few faculty members participate in the ones that exist. Recommendation #2 is

crucial to increasing participation. Recommendation #3 deals with increasing the number and variety of such coalitions.

3.1 Universities – Implementing Recommendation 3

3.1.1 **Develop and improve ways in which faculty members and students routinely discuss improvements in courses in their disciplines, within and across institutions**.

Sometimes these conversations can be side benefits of the organization of academic work. The MIT Department of Electrical Engineering and Computer Science appeared to be almost unconscious that its approach to teaching multi-section courses had this side benefit, yet it was a crucial step to inspiring faculty to experiment with xTutor in their courses. The MISTI program enabled MIT undergraduates in China to disseminate information about iLabs, to discover the iLabs work of Prof. Zhu at Zhejiang University.

Other innovative strategies for fostering exchange among faculty have been devised consciously and thoughtfully. The Cambridge-MIT Institute was designed to encourage a variety of forms of collaboration between faculty at the two institutions, and one impact was the MIT-Cambridge collaboration around heat transfer iLabs. Kapi'olani Community College has a new practice which helped the dissemination of XMAS: faculty members can easily and publicly invite all their colleagues to come and visit their courses. Mark Lawhorn got an audience for his use of XMAS: faculty who could not only watch him teach but also talk with his students after class about the innovation.

3.1.2 **Provide adequate support for faculty to participate in coalitions**

This support can include recognition of the time it takes to participate in online discussions and read journals and online materials, as well as travel support to local, national and international conferences.

3.1.3 **Offer special rewards for faculty who invest time to help assure that such coalitions work**,

Reward faculty who volunteer time to serve on committees of associations or serve as officers, especially where that work helps the association focus more on sharing teaching ideas in the discipline.

3.2 Government Agencies and Foundations – Implementing Recommendation 3

3.2.1 **Fund well-staffed, long-term, content-specific coalitions with the responsibility for reaching out to *all* faculty members nationally who teach that course or small group of courses**.

Where possible these coalitions should be co-sponsored or hosted by the relevant professional association, which can also host its events at association meetings. The United Kingdom already has a network of subject centers that bears some resemblance to what we recommend here.[79]

[79] For more information on the network of subject centers in the United Kingdom supported by its Higher Education Academy, see http://www.heacademy.ac.uk/SubjectNetwork.htm . The Academy, which is government-supported, also oversees an extensive program of continuing professional education and certification of faculty members in the arts and sciences of teaching.

It also makes sense to see such coalitions as an element of the scholarship of teaching and learning (SoTL). This concept of faculty work, originally outlined by Boyer (1997), involves using evidence, one's own as well as evidence gathered by colleagues, to improve teaching. SoTL is different from educational research in that it is the secondary discipline of the faculty member. Its primary goal is local findings: 'What can I learn from my students in order to help my students and my colleagues?' Such inquiries today are often handicapped by the fact that the faculty members involved know little or nothing about whether educational researchers and other faculty members in their disciplines have discovered in the past. They typically do not even know what terms to use in order to search the literature of education and technology generally or in their disciplines. Coalitions for instructional improvement organized around SoTL would have at least two benefits for faculty: helping them build on prior inquiries (methods, existence proofs, theories) and helping them share their own methods and findings with others.

Each subject coalition should harvest, evaluate and share good practices, materials, tools. Dissemination methods should include digital libraries with frequent broadcast mailings about instructional ideas, online workshops, special journal issues, and events at the relevant professional association(s). Use services such as MERLOT to make resources even more visible across disciplinary lines: although many innovations are content-specific, many others are interdisciplinary, so it is important to assure that networks work smoothly together.
These coalitions should also prepare 'primer' material to help introduce novice faculty and graduate students to some of the most important findings, achievement and language of the relevant fields. The goal: equip faculty as efficiently and easily as possible with the basic tools needed to seek out relevant resources and to make their own improvements to their own teaching.

Economics: Such networks won't work (and would be too expensive) if they were 100% subsidized, and would likely be too expensive if their work had to be supported entirely by fees. **So experiment with different economic models for long-term support of such networks**. A hybrid model based either on steady but partial subsidies, or government/foundation matching of user fees, may well be the best.

3.3 Corporations – Implementing Recommendation 3

3.3.1 **Support the kinds of outreach networks described above through grants of money, equipment, and staff support**.

In the 1980s, IBM helped start the National Technological University, a multi-institution consortium for offering technical and management degrees online, by providing staff support as well as financial support.

3.3.2 **Investigate the feasibility of a service to help faculty members who teach comparable courses to share information on how they teach and assess, share materials, and even collaborate in teaching**.

Step by painful step, 'course management systems' have begun to move outside the box of the course and become institutional learning management systems. These systems still operate inside institutional walls (other than the import of publisher materials). It would be of great advantage if the systems (or some other infrastructure) made it easier for faculty to find colleagues at other institutions who are teaching similar courses to similar students on similar academic calendars. It would be better still if that infrastructure facilitated collaboration among those faculty members.

One side effect of such a service would be to create more coalitions for instructional improvement. Such a service might be commercially attractive. If successful, it would be a powerful engine to help new ideas, materials and technologies spread rapidly across institutions.

3.4 Additional Recommendations Specifically for MIT

3.4.1 **Study how various departments teach multi-section courses, and the impact of various teaching practices on the testing and sharing of ideas for teaching the course**.

For example, are there other instances were such faculty teaching communities fostered the spread and adoption of innovative practices? What roles can undergraduates play in these course meetings? Does their participation inject new ideas or alter faculty and graduate student participation? Do some courses or departments have a culture that encourages especially frank and productive discussions?

Based on the experiences of the EECS Department with iLabs and xTutor, MIT might want to study this theme in MIT alone, or in concert with other institutions. In either case, it appears to us that this practice deserves more visibility inside and outside MIT.

3.4.2 **As a collaborator in Sakai, MIT should consider whether Sakai[80] can and should support the kind of inter-institutional collaboration capabilities described in Recommendation 3.3.2**.

Recommendation 4. Create more higher education-corporate alliances in order to support the development and dissemination of new educational technology materials and practices.

The successes of the MIT-Microsoft Alliance suggest that university-corporate alliances can accomplish things that the parties working alone would have found more difficult, or impossible The challenges faced by the Alliance suggest some of the guidelines that such alliances should follow.

The single most important observation to make is that universities and corporations have different goals and capabilities (though not so different as it might seem). The need to produce a synthesis – something that neither party could do alone – is the reason for creating an alliance. Those very differences are, of course, what can make an alliance unless the parties plan and work to deal with the tensions.

One early problem: people on both sides may assume that the 'alliance' is a simple gift of money from the corporation to the university's faculty. The corporation's responsibilities end with the cutting of the check, and the university's faculty are then free to use the money as they wish.

An alliance is appropriate when each side has something active to contribute to the ultimate goal. A few examples of these varied contributions, from the iCampus experience:

- MIT faculty had many ideas for how to use technology to improve their courses.
- Microsoft staff had substantive contributions to make to those educational ideas.
- Microsoft staff made many kinds of contributions to the project management and support process, helping to assure successful completion of projects.
- Microsoft contributed tools and ideas to the software development process.

This list is intended to be suggestive, not comprehensive. There were also tensions in the relationship, many of which were creatively resolved: over issues of intellectual property and

[80] Sakai is an open source learning management system being collaboratively developed by a coalition of universities, including MIT. For more on Sakai, see http://www.sakaiproject.org/.

liability, over issues of benefits of the funding for institutions other than MIT, and over evaluation.

Each party should clarify its own goals, and the goals of its potential partners, in order to design an alliance that can achieve goals that neither party could achieve as well alone. This clarity should extend to staff members and their units, as well as to the universities and corporations as organizations.

Does the university want collaborators and support for exploratory research, or is the main goal broad implementation of a new practice, for example? Is the corporation looking for products to sell? Great demonstrations for marketing? A broad-based change in technology use that could help increase demand for its products? A way to contribute to its community? What do the staff members get from the collaboration? What do their departments want to achieve?

If the parties are being honest with each other, it's likely that, at first, they will realize that their goals are not wholly compatible or fully achievable.

For example, a program that is designed to test a variety of exploratory novel ideas is not likely to achieve institution-wide or nationwide changes in practice, or definitive evaluation results. And, by the same token, a program that aims at producing nationwide or lasting institutional change will likely have to sacrifice many kinds of innovation in the interests of focus. These two kinds of initiatives differ in other ways as well: innovative, exploratory initiatives are usually relatively decentralized in structure, supporting a variety of parallel projects. In contrast, initiatives designed to achieve sustained, widespread, and documented changes in practice and outcomes may be more centralized and more varied in their activities – training programs, evaluative projects, market research, software development, space renovation, and many other types of work.

The contributions of educational institutions and corporations will differ by the goals of the alliance. For example, in a FIPSE-supported alliance in the 1980s, the corporations developed software while the colleges typically provided specifications and, as development proceeded, test beds and evaluation. In an initiative aimed at widespread adoption of new practices, the corporations might provide employment for graduates, external evaluation, and support from sales and marketing that might help spread ideas and practices more rapidly to large numbers of educational institutions.

The same kind of clarity is needed concerning the nature of the contributions each partner will make. Almost fifty years ago, Margaret Luszki (1958) studied many cases of interdisciplinary team research and found that a major cause of collapse was unintentional over-promising. A philosopher would be included in the team because 'philosophers know everything about ethics' or an economist would be included because 'economists understand everything about business.' Members of the team over-estimated the contributions of their new partners and then, when reality didn't meet hope, they often swung to the opposite extreme, erroneously concluding that their partners could contribute nothing at all. Universities and corporations often assume that they understand one another better than they actually do. In starting such an alliance, it's important for the partners to develop *realistic* expectations of one another, as soon as possible.

If the early conversations reveal incompatible aims among the parties (within the universities, within the corporation(s), and between them), we suggest trying harder to develop more limited and disciplined goals that can actually be achieved by the alliance better than the parties could do alone. **Put these goals in writing, and make sure that the parties have a shared understanding of what the words mean.**

Reaching a shared agreement is especially important because initiatives such as these often need to last many years. Staff on both sides are likely to change roles and it's important for

the success of the project that newcomers be chosen because they wish to continue pursuing the original shared goals.

This kind of upfront clarity is difficult to achieve in the real world, and many past initiatives in this field have been launched without clear, shared goals. The results, however, have often left a bad taste in the mouths of one or both parties, and a lasting reluctance to partner again.

In preparing action plans, partners in cross-sector collaborations should **be careful of calendars**. The schedule for preparing corporate budgets may not match the academic's calendars for preparing proposals. iCampus was able to cope with that because Microsoft had made a multi-year commitment of funds: MIT faculty did not have to write proposals and progress reports each year to justify funds for the next year, which was fortunate because the two calendars did not match. The calendar problems can extend to other elements of project management. For example, in a 1980s collaboration that involved Brown University, IBM, Apple, and the Annenberg/CPB Project, the cross-sector project was delayed a year because the product was to be tested in courses that Brown taught only once a year: a slight delay in the delivery of a product from a vendor resulted in a major setback for the project at the university.

4.1 Universities – Implementing Recommendation 4

4.1.1 **Host corporate staff on campus to help make the alliance work**:

One way to develop such realistic understandings, and to make an alliance work, is for the university to host representatives of the corporate research staff on campus, to help create the relationships that make the alliance function. MIT benefited substantially from the presence of Microsoft staff on campus: Microsoft staff worked with MIT faculty to help with proposals, aided in developing good standards of project management, and, as noted above, helped foster collaboration between MIT staff and Microsoft staff at other locations.

In some kinds of educational collaborations with corporations, government agencies or foundations, universities may also be find it useful to arrange for faculty members to spend extended time on site at the partner institution.

4.1.2 **Consider whether and how policies for managing external funds need to be aligned with the initiative, and vice versa, to assure adequate flexibility.**

Projects of this sort often do not call neatly into pre-agreed categories such as "research" or "gifts" when it comes to using funds and dealing with institutional overhead. It may be important to 'commingle' funds from different sources, to use corporate funds to challenge or match foundation grants, or to pay staff who are also being paid through other sources. In cases such as these, institutional and government policies can sometimes hamstring initiatives. The initiative and the policies need to be understood and adjusted, at the start, so that the initiative is itself manageable.

4.2 Government Agencies and Foundations – Implementing Recommendation 4

4.2.1 **Support more R&D projects with higher education and corporate partners.**

Cutting edge research in cognitive science, engineering, or training may occur in universities, corporations, government agencies or non-profits. Foundations and government agencies ought to help create such cross-sector partnerships, through the design of their grant competitions and by proactively bringing parties together. In the 1980s, the US Department of Education's Fund for the Improvement of Postsecondary Education (FIPSE) supported a proposal from the League for Innovation in the Community College to create an incubator in which representatives of

colleges and corporations met twice a year to discuss joint ventures. Many such alliances were created by the League's incubator.

4.3 Corporations – Implementing Recommendation 4

4.3.1 **Budget for staff who will work on campus to help make the alliance work**

MIT benefited substantially from the presence of Microsoft staff on campus. To assure healthy collaboration between local faculty and staff at the partner institution, consider housing some partner staff on staff to act as liaison and project support. In MIT's case, this has many benefits beyond the technical: the Microsoft staff helped assure that good standards of project management were in play, for example.

For some alliances it is useful for the corporation to host higher education staff on site to aid collaboration and help the higher education staff learn about the corporation's side of the alliance.

4.3.2 **Fund more collaborative R&D projects that involve faculty at multiple institutions working with corporate staff.**

One way to increase the chances for wider adoption of software and associated ideas for using that software in teaching would be through collaborative development involving faculty from multiple institutions. The developers could be at several institutions, or development might be focused on one institution with a powerful role being played by a council involving faculty from several institutions as well as other experts. The Annenberg/CPB Project in the 1980s and 1990s oversaw the development of multi-million dollar projects using such advisory councils that involved representatives of different types of users, technology experts, and outreach experts.

4.3.3 **Take responsibility for promoting adoption of ideas and materials emerging from the collaboration by allocating corporate staff and budget to the task.**

Corporations often have better facilities for a) usability testing, b) marketing. In many collaborations, the corporation needs to play a strong role in spreading the use of project ideas and materials. In our experience, while corporations may lack insight into the culture of the adopting educational institutions, they may have capabilities than universities for planning and carrying out outreach campaigns. So outreach is one of several areas where it may be important for the university and corporation to think and work together.

For example, dissemination messages need to attract attention of potential faculty users and the staff who support them at institutions: in a few seconds, the message should make clear how and why the innovation could be of use. Once the users have decided that they might be interested, good adoption materials are needed. Adoption materials should make it clear to potential users a) what kinds of short-term and long term educational gains are possible, b) how the innovation can cost time, and save time, c) what other costs and preparation will be involved. The adoption materials ought to be painfully honest about these issues: honesty builds credibility

4.4 Additional Recommendations Specifically for MIT

4.4.1 **Carry out an internal review of iCampus projects**.

The MIT-Microsoft Alliance has produced a number of projects of great potential, beyond the five studied in this report. MIT should review all of them in order to decide whether and how institutional resources should be invested in the continued development and dissemination of the most promising of these projects.

Recommendation 5. Supply faculty innovators with central services in educational design, software development, assessment methods, formative evaluation, and/or in sharing ideas with others who teach comparable courses.

Many of the successes of iCampus were made possible, or enhanced, by services provided by MIT and Microsoft, and shared by two or more projects. And, in our judgment, some of iCampus's frustrations were due to a lack of such services. Few institutions of higher education allocate enough of their staff resources and budgets to provide a full constellation of support services needed for faculty members to create, test, and disseminate improvements in learning.

5.1 Colleges and Universities – Implementing Recommendation 5

5.1.1 **Discover 'low threshold' improvements that individual faculty have made and then 'broadcast' these time-saving improvements to all interested faculty**.

When we think of 'innovation,' the first thought may be large, grant-funded projects such as those funded by iCampus. But the bulk of the improvements that faculty members need to make in order to make instruction more authentic, active, collaborative, and feedback-rich are incremental: ideas and applications that are can be grasped, implemented and assessed with minimal effort, expense and risk. We call such ideas and applications *low threshold*.[81]

One important way to accelerate the spread of ideas and the improvement of teaching is to intentionally search for and distribute a large volume of such low threshold activities and applications To implement Recommendation #1 in this report, universities should gather descriptions of such low threshold activities and applications, and then disseminate them widely and frequently to faculty. One important source for such 'low threshold' ideas is the institution's own faculty: it's almost certain that any idea that helps one faculty member teach and save time, is an idea that another faculty member would love to learn. Another source of low threshold activities and applications is faculty members at other institutions who teach comparable courses. Special priority should be put on ideas that are also time-savers for the faculty who adopt them. **Distribute those ideas via e-mail and other means to all interested members of the faculty**. Interested faculty members might receive one such idea, a few sentences long, every day, or every week. The ultimate goal, over the years, is to make a series of incremental improvements, different in every course, that add up to large gains for students in authentic learning, active learning, collaborative learning, and feedback-rich learning at the institution.

5.1.2 **Provide guidance for innovators on educational design and assessment** (i.e., techniques for measuring what students are learning).

Most faculty members working on innovative uses of technology could benefit from help with learning theory and instructional design. The developers of TEAL benefited from many sources of such help, thanks to the relatively mature state of physics education research. Judi Dori of the Technion played an important role in helping faculty learn from the field of physics education research. SCALE-UP provided additional ideas and research.

TEAL was unusual in this respect. In our interviews with them, iCampus leaders said they regretted not providing more extensive and forceful assistance in this area to many of their project leaders. Universities should provide active oversight of projects receiving major funding from the university and, if this assistance is ignored to the detriment of the project and the students, withhold further support for development.

[81] For more background on low threshold activities and applications, see http://www.tltgroup.org/

5.1.3 **Provide programming support so that projects use common tools and create well-documented software so that products are easier to maintain and disseminate.**.

Centralized programming services have a number of potential advantages: expensive programming and project management tools can be amortized across many projects; skills and standards for project management can be developed and then used across many projects as well.

iCampus had many experiences demonstrating the need for, and the value of, sharing programming services. The first round of iLabs projects were developed separately by faculty and programmers in different departments, so each lab got its own version of what were, functionally, the same services (e.g., authentication). iCampus reacted by essentially forcing a fresh start on software development, intended to provide those services through shared architecture. CECI provides shared programming and administrative services that have helped iMOAT become self-sustaining while aiding cross-fertilization (several programmers have worked on multiple iCampus projects). CECI is also documenting iMOAT code.

Centralization is no panacea, especially if the centralized services are less than competent or responsive. The ideal for large projects such as those funded by iCampus is to have some creative tension between the ideas and capabilities of the innovator and the ideas and capabilities of the central programming staff.

5.1.4 **Provide services and support for formative and summative evaluation**

Innovative faculty members often lack the skills, time and interest for doing effective formative or summative evaluation.

For summative evaluation, there is also a potential conflict of interest between the innovator and the university (as a representative of both students and the ultimate funders of the project and of the program that supported it). A purely external summative evaluation is often not feasible however, since the full collaboration of the faculty member is important to a good design. So the evaluator needs to be candid and skillful in negotiating with all stakeholders.

Faculty and evaluators doing local, formative evaluation should agree before starting a project that all data should be accessible (with due anonymity) for use in formative and summative evaluation of the program as a whole.

5.1.5 **Provide dissemination/adoption support for innovative ideas and materials**.

Promotion of adoption of ideas, inside and even outside the institution, is in the institution's vital interest. It is simply not possible to adopt to changing conditions without adopting ideas from outside, and one important way for faculty to learn about new ideas outside is to export their own. In Chapter 9, Finding B, we described how difficult and unrewarding it is for innovative faculty to undertake such 'exporting' activities totally on their own. iCampus engaged an Outreach Coordinator and provided approximately 10% of its total grant (about $2.5 million) in support of outreach activities. Universities and colleges should provide staff and budgets to support the wider, longer term use of selected, innovative ideas and materials to which their staff have contributed.

Among the important contributions that such outreach staff should make in working with interested faculty:

- Working with faculty to develop **disciplinary channels of communication**: identifying listservs, web sites, conferences, journals and other appropriate ways to make the idea or material visible to potential adopters.
- Developing and transmitting **messages that can attract the attention of potential adopters**. Such messages often deal with ways in which the target ideas or materials can

be used to advantage and a quick summary of the investment or risk needed to adopt them. iCampus materials often made the mistake of focusing on how their software was innovative, rather than on why and how it might best be used.

- Developing ways for potential adopters to **experiment with the target ideas as easily and freely as possible**. iCampus made some of its software available online, for use directly over the Web or for download.
- **Handling some of the load when potential adopters call or visit**, either directly or by arranging for release time for the innovators.
- **Developing personal connections with important gatekeepers in relevant associations and institutions.**

5.1.6 **It is sometimes appropriate to require development projects to attend to adoption issues from day 1.**

iMOAT is an excellent case in point. Principal investigator Les Perelman recognized that widespread adoption was crucial to the survival of iMOAT, even at MIT, and so he invited potential institutional users to help design the specifications and then review designs and test software. iCampus then insisted that iMOAT also develop a business plan to support long-term operations and upgrades; that also focused iMOAT staff attention on the needs of adopters.

5. 2 Government Agencies and Foundations; Corporations Funding Faculty Development Projects – Implementing Recommendation 5

5.2.1 **Insist that faculty developing innovative uses of technology get all the kinds of help they need: educational design, programming, assessment, program evaluation, and dissemination**; budget funds for these services where necessary.

Any grant will subtly either insulate the innovation and innovator from the institution (e.g., when the grantee does all the work with staff working exclusively on the grant) or integrate the innovation with the institution (e.g., when the grantee gets help from central services of the institution). The choice between these two options depends in part on the match, or mismatch, between project goals and institutional goals. Other things being equal, **if the goals of the project are a good fit with the institution, encourage the grantee to draw on core services and, ideally, strengthen the services as well as the project in the process. If there is a clash between the goals of the innovation and the institution's culture, such services should be budgeted for the project and under the control of the principal investigator and the funder**.

It's tempting to fund more projects by providing less funding per project. But projects without these kinds of support are less likely to be completed, to be educationally effective, to produce documentation of success, and to be disseminated.

5.3 Additional Recommendations Specifically for MIT

5.3.1 **Provide specialized staff within Schools and departments who can help faculty members learn about educational developments elsewhere, develop their own innovations and adaptations, assess learning, evaluate their experiments, and disseminate their work to colleagues at MIT and elsewhere**.

These innovations staff should work with central staff in units such as academic computing and the Teaching Learning Laboratory, but they should ideally be sited within the departments, and have disciplinary backgrounds that help them work with faculty on subject-specific innovations,

as well as technology and education backgrounds that help them deliver the range of services needed to support the development, evaluation, and dissemination of innovations.

We particularly stress the role of these specialized staff to find interested faculty, understand what they might need, and then actively seek out innovations elsewhere that faculty might adopt, including subject-specific innovations. "Not Invented Here" and "Not Invented by Me" are crazy slogans for over-committed faculty. The single best way to improve learning at MIT may be to increase the rate in which it selectively and wisely adapts educational innovations from outside.

Funding staff such as these obviously represents a choice about the allocation of resources. In some cases, they will be able to help the institution attract grants and gifts for instructional improvement. But the real test of their value will be whether they can help improve the effectiveness of teaching and learning in the departments they support.

5.4.2 **Provide more support for units that can provide innovative faculty with assistance in educational design, programming, assessment, program evaluation, and dissemination**.

The specialized disciplinary staff described in recommendation immediately above cannot work alone; they need to be supported by, and be intermediaries for services from, strong central units providing services in these areas.

5.4.3 **Support iLabs Shared Architecture as a base service for the next five years**.

Assuming that the review of iCampus projects recommended in 1.4.2 above supports the further use of the iLabs Shared architecture, MIT should assure faculty that the Institute will make the Architecture, and help in using it, available for at least five years. Faculty members are unlikely to invest their time in innovations that may disappear in a year or two, so a longer-term commitment is necessary. It will take years to develop and test additional types of experiments, and to evaluate the results of these educational innovations. Other comparable services may also be necessary to support faculty in implementing Recommendation #1: gradual improvement in authentic, active, collaborative and feedback-rich learning.

Recommendations in Brief

Recommendation 1. Improve education by making it more authentic, active, collaborative, and feedback-rich. iCampus software and ideas can provide useful elements for such a campaign.

1. 1 Colleges and Universities – Implementing Recommendation 1

1.1.1 Decide, at the institutional and programmatic level, whether and how to implement this recommendation; include other stakeholders in the discussion.

1.1.2 Give preference in hiring to faculty candidates with a demonstrated preference for, and skill in, these types of teaching.

1.1.3 Grant release time for major course improvements, with preference to faculty who work together on the same course, or sequences of courses.

1.1.4 Use these goals as criteria for awarding discretionary funding for curricular development, new technology, space renovation, and other purposes, and as themes for soliciting funds from alumni, legislatures, foundations, and other sources.

1.1.5 Academic computing, the teaching & learning center, distance learning, the library and any other units responsible for professional development and course improvement should coordinate and organize their collective efforts around these goals.

1.1.6 Develop and maintain assessment procedures to guide progress on these goals within academic programs.

1.2 Government Agencies and Foundations – Implementing Recommendation 1

1.2.1 Support model campaigns for curricular improvement within institutions.

1.2.2 Support development of appropriate methods for assessing these teaching/learning activities and outcomes in the disciplines.

1.2.3 Continue to support exploratory R&D.

1.2.4 When considering new proposals for funding, recognize that, even at the proposal stage, it is possible to assess how adoptable the ultimate product or idea might be.

1.3 Corporations – Implementing Recommendation 1

1.3.1 Support education/technology campaigns with money, corporate staff collaborating with university staff, dissemination support through marketing.

1.4 Additional Implementation Recommendations Specifically for MIT

1.4.1 Move forward with these five projects.

1.4.2 MIT should systematically review all educational innovations supported with major grants from sources such as iCampus in order to determine which deserve internal support for wider deployment or further development.

Recommendation 2. Create demand to adopt ideas and materials from other sources by encouraging all faculty members to improve and document learning in their programs, year after year.

2.1 Universities – Implementing Recommendation 2

2.1.1 Assist and reward *all* faculty members who discover, adapt and share practices and findings from other institutions as part of the process of improving their academic programs.

2.1.2 Alter procedures and criteria for hiring, promotion and tenure in order to find and support faculty members who will continually import ideas as part of their effort to improve and evaluate their teaching.

2.1.3 Discretionary funding programs should challenge and support faculty to adopt best practices from around the world.

2.1.4 Specialists, such as reference librarians, staff in information technology, and staff in teaching and learning centers, should work together to help faculty seek out relevant ideas and materials in their disciplines.

2.1.5 Regional and professional accreditors should evaluate institutional and departmental track records for importing and incorporating ideas and practices into the teaching, across the curriculum.

2.2 Government Agencies and Foundations – Implementing Recommendation 2

2.2.1 Explore ways of providing faculty development opportunities in which *all* interested instructors nationally can participate.

2.2.2 Provide grants to help faculty and departments adopt and adapt promising new practices for teaching in their disciplines.

2.3 Corporations – Implementing Recommendation 2

2.3.1 When funding faculty to apply new technology to educational problems, insist their proposals build on relevant improvements from other institutions, especially developments in their own disciplines.

2.4 Additional Recommendations Specifically for MIT

2.4.1 Requests for discretionary funding for faculty to improve their teaching should be assessed against best practices worldwide.

Recommendation 3. Nurture coalitions for instructional improvement, within and across institutions.

3.1 Universities – Implementing Recommendation 3

3.1.1 Develop and improve ways in which faculty members and students routinely discuss improvements in courses in their disciplines, within and across institutions.

3.1.2 Provide adequate support for faculty to participate in coalitions.

3.1.3 Offer special rewards for faculty who invest time to help assure that such coalitions work.

3.2 Government Agencies and Foundations – Implementing Recommendation 3

3.2.1 Fund well-staffed, long-term, content-specific coalitions with the responsibility for reaching out to all faculty members nationally who teach that course or small group of courses.

3.3 Corporations – Implementing Recommendation 3

3.3.1 Support the kinds of outreach networks described above through grants of money, equipment, and staff support.

3.3.2 Investigate the feasibility of a service to help faculty members who teach comparable courses to share information on how they teach and assess, share materials, and even collaborate in teaching.

3.4 Additional Recommendations Specifically for MIT

3.4.1 Study how various departments teach multi-section courses, and the impact of various teaching practices on the testing and sharing of ideas for teaching the course.

3.4.2 As a collaborator in Sakai, MIT should consider whether Sakai[82] can and should support the kind of inter-institutional collaboration capabilities described in Recommendation 3.3.2.

Recommendation 4.Create more higher education-corporate alliances in order to support the development and dissemination of new educational technology materials and practices.

4.1 Universities – Implementing Recommendation 4

4.1.1 Host corporate staff on campus to help make the alliance work.

4.1.2 Consider whether and how policies for managing external funds need to be aligned with the initiative, and vice versa, to assure adequate flexibility.

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[82] Sakai is an open source learning management system being collaboratively developed by a coalition of universities, including MIT. For more on Sakai, see http://www.sakaiproject.org/.

4.2 Government Agencies and Foundations – Implementing Recommendation 4

4.2.1 Support more R&D projects with higher education and corporate partners

4.3 Corporations – Implementing Recommendation 4

4.3.1 Budget for staff who will work on campus to help make the alliance work.

4.3.2 Fund more collaborative R&D projects that involve faculty at multiple institutions working with corporate staff.

4.3.3 Take responsibility for promoting adoption of ideas and materials emerging from the collaboration by allocating corporate staff and budget to the task.

4.4 Additional Recommendations Specifically for MIT

4.4.1 Carry out an internal review of iCampus projects.

Recommendation 5. Supply faculty innovators with central services in educational design, software development, assessment methods, formative evaluation, and/or in sharing ideas with others who teach comparable courses.

5.1 Colleges and Universities – Implementing Recommendation 5

5.1.1 Discover 'low threshold' improvements that individual faculty have made and then 'broadcast' these time-saving improvements to all interested faculty.

5.1.2 Provide guidance for innovators on educational design and assessment (i.e., techniques for measuring what students are learning).

5.1.3 Provide programming support so that projects use common tools and create well-documented software so that products are easier to maintain and disseminate.

5.1.4 Provide services and support for formative and summative evaluation.

5.1.5 Provide dissemination/adoption support for innovative ideas and materials.

5.1.6 It is sometimes appropriate to require development projects to attend to adoption issues from day 1.

5. 2 Government Agencies and Foundations; Corporations Funding Faculty Development Projects – Implementing Recommendation 5

5.2.1 Insist that faculty developing innovative uses of technology get all the kinds of help they need: educational design, programming, assessment, program evaluation, and dissemination; budget funds for these services where necessary.

5.3 Additional Recommendations Specifically for MIT

5.3.1 Provide specialized staff within Schools and departments who can help faculty members learn about educational developments elsewhere, develop their own innovations and adaptations, assess learning, evaluate their experiments, and disseminate their work to colleagues at MIT and elsewhere.

5.3.2 Provide more support for units that can provide innovative faculty with assistance in educational design, programming, assessment, program evaluation, and dissemination.

5.3.3 Support iLabs Shared Architecture as a base service for the next five years.

References

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Ehrmann, Stephen C. (2002), "Improving the Outcomes of Higher Education: Learning From Past Mistakes," *EDUCAUSE Review,* Jan.-Feb., pp. 54-55. On the web at http://www.tltgroup.org/resources/Visions/Improving_Outcomes.html

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Attachment 1: Glossary of Terms Used in this Report

Active learning: Chickering and Gamson (1987) wrote, "Learning is not a spectator sport. Students do not learn much just by sitting in classes listening to teachers, memorizing pre-packaged assignments, and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences and apply it to their daily lives. They must make what they learn part of themselves." Active learning has been defined in at least two ways: one focuses on what's visible to others about learning. Chickering and Gamson, and this report, use this definition. The other definition focuses purely on what goes on inside the learner's mind; in this sense, learning is active when the learner is continually querying and challenging experience, even if that is done silently. By this definition, a lecture can be an active learning experience if the learner treats it that way.

Authentic learning: Learning is called 'authentic' to the extent that the student's activity and audience are like those of the world in which the student might work and live after graduating. For an engineer, listening to a lecture, no matter how gripping and informative, is less authentic than working on a realistic design problem, then testing the resulting product, and being assessed by professional engineers. Tasks for students are termed authentic when they are as real, messy, and compelling as those found in the world of work. Assessment when a) the student has carried out an authentic task, and b) when the feedback resembles that of the real world – does the device work? Is the client pleased?

Coalitions for instructional improvement: Any set of educators whose routine interactions make it normal for them to discuss how they are teaching, and how they are trying to improve learning, in their courses and academic programs. Team teaching, professional associations with a focus on teaching, listservs that support teaching discussions in a discipline, and certain inter-institutional alliances such as the Cambridge-MIT Institute are all examples of coalitions for instructional improvement. Coalitions create the routine, trusted communications patterns that help ideas move and improve.

Collaborative Learning: when learners work together on a task designed to help them master ideas and skills more effectively than if they had each worked alone. Part of the power of collaborative learning comes from mutually beneficial peer instruction. The students who are a bit ahead learn by helping their peers catch up. The students who need to catch up learn because their peers have only recently been in the same situation as they are, and can help them over the hump. Many kinds of learning can occur through collaboration.[83]

Curricular software: software that is content-specific. By this definition, a course management system like xTutor is not curricular software; however, the Scheme course built on xTutor is. The same is true for the semiconductor device characterization experiment (an iLab) and TEAL. XMAS is close to being curricular software, because it does include Shakespeare resources, but it is also a flexible curricular tool that can be applied to other kinds of courses.

Educational Technology Initiative: A spending program whose goal is to encourage wider, more successful educational uses of technology. This report focuses on two types of initiatives, Educational Technology Explorations and Education/Technology Campaigns.

Educational Technology Exploration: An initiative whose goal is to explore or invent many types of educational uses of a technology by support of a variety of faculty-led development projects. Explorations are defined more by their technologies than by their educational goals. Their success should be measured by the importance of the discoveries or inventions made by the

[83] For an example from MIT of the power of collaborative learning, see Ehrmann (undated)

best of their projects and by benefits gained by the students in those pilot tests. Progress toward those educational goals is therefore usually difficult or impossible to assess. iCampus is an example of an Educational Technology Exploration.

Education/Technology Campaign: An initiative whose goal is to create a particular, relatively well-defined educational improvement (e.g., in a university). The campaign's goal is, by definition, partly defined by the capabilities of a technology. The success of the Campaign should be measured by progress (e.g., of that university) toward that goal that is the direct result of the campaign. TEAL is an example of a university-level Education/Technology Campaign. Its primary goal was to improve conceptual understanding and attendance in first year physics courses, and its physical technologies were specially designed classrooms equipped with personal response systems, simulations, and laboratory equipment.

Feedback-rich learning: Learning experiences that provide frequent, compelling, and rapid response to what learners do. Science laboratory experiments, personal response systems, online feedback for computer science programs, and online discussions annotated with video illustrations are examples of rich, rapid feedback provided by these iCampus projects.

Low Threshold Activities and Applications: An activity or application is 'low threshold' for the potential adopter if it can be grasped, learned, used, and assessed with minimal effort, expense and risk. In fact many LTAs are time-savers and risk-reducers. An LTA is an activity or application that can be appreciated in seconds, learned in minutes, and assessed after use just as quickly. It involves little or no expense for either the user or the institution. "Low threshold" is a relative term, relative to the potential user's skills and interests and to the infrastructure which supports that person. An idea that is attractively low threshold for one person is something that a second person is already doing, that would be difficult for a third person to learn, and is uninteresting or inappropriate for a fourth. For more on LTAs, see http://www.tltgroup.org/ltas.htm.

PI: Principal Investigator. The faculty member or members in charge of an individual iCampus development project.

References

Chickering, Arthur and Zelda Gamson (1987) "Seven Principles of Good Practice in Undergraduate Education," *AAHE Bulletin* (March).

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