If information technology skills are increasingly important in the world outside of higher education, then certainly educators need to examine the programs of study at their institution to see how they are preparing students to survive and thrive in the technology-rich environment that has now permeated all areas of life.

Information literacy, fluency in information technology (IT), technology across the curriculum, general education requirements, ubiquitous computing—there are many models for introducing technology into academic programs, but no silver bullet that meets the needs of every institution. We are not attempting here to define one approach that every institution should take. Instead, we focus on factors that every institution needs to consider in successful curriculum development for fluency in information technology and information literacy, and we offer examples of strategies that can address these factors. Although we present these factors linearly, they are really recursive—consideration of any one factor may lead back to reconsideration of others.

In addition, although we focus here on curriculum development for undergraduate education, we recognize that the strategies we identify also have broader application to the design of continuing training programs for workforce development at the college or university level or in the work setting. The growing industry of IT-related training needs to be cognizant of the same range of factors as academic
institutions in order to create successful programs. Supplying information technology workers and IT-enabled workers is a task that higher education shares with employers, and both sectors need carefully planned strategies to be effective in meeting that responsibility.

In our discussion, we have used examples from George Mason University’s Technology Across the Curriculum (TAC) initiative because we are most familiar with it, but we would be the first to acknowledge that George Mason’s program was designed to fit this institution’s particular circumstances and is not necessarily appropriate at another institution. (Specific information about the TAC program is available on the Web at cas.gmu.edu/tac/.)

Preliminary Definitions

Information literacy and information technology fluency are overlapping but distinct competencies. They are complementary to each other—in today’s world an information technology fluent person must also be information literate, and vice versa. In this context, the aim of fluency in information technology tends to focus on the technology itself; the goal of literacy is primarily concerned with the intellectual framework of dealing with information. Both competencies, however, require development of a continuum of evolving skills that become possible through mastery of interrelated concepts and cultivation of broad intellectual capabilities.

In Part One of this book, Herbert Lin gives an overview of what IT fluency consists of and comments upon its critical importance, drawing on the findings of a National Research Council study (1999). Mastery of the three types of knowledge (contemporary skills, foundational concepts, and intellectual capabilities) characterizes fluency in information technology, or FITness. These are the essential building blocks for acquiring knowledge of and sustaining the process of lifelong learning for FITness, bolstering a person’s ability to succeed in the dynamic environment of information technology. Although the concept of FITness clearly goes well beyond the mechanical type
of learning typically associated with computer literacy (some might label it vocational training), its focus nevertheless remains information technology itself—hardware, software, networks, and so forth.

In contrast, the central concern of information literacy “is an intellectual framework for understanding, finding, evaluating, and using information—activities which may be accomplished in part by fluency with information technology, in part by sound investigative methods, but most important, through critical discernment and reasoning” (Association of College and Research Libraries, 2000, pp. 3–4). Development of information literacy focuses on information itself:

• Determining the nature and extent of information needed
• Finding and accessing needed information effectively and efficiently, whether it is available in the library, on the Web, from a government agency, in a book or journal, or in a map
• Critically evaluating information and its sources and using it effectively
• Understanding the ethical, legal, economic, and social uses of information

Like FITness, information literacy aims to develop, foster, and sustain lifelong learning. But unlike FITness, information literacy abilities are not exclusively or ultimately intertwined with or dependent on information technology.

**Ten Keys to a Successful Program**

In thinking about how to integrate either or both of the related concepts of IT fluency and information literacy into the curricula of an institution, we have identified ten factors as crucial elements in a successful program.
Determine Your Institutional Stakeholders

An environmental scan is an important early step in addressing technology in the curriculum. Who cares, or might potentially care, about this issue? The list is certain to vary from institution to institution, but here are a few suggestions:

- Does your governing board take a strong interest in curriculum?
- Has your regional accrediting agency or state higher education board set guidelines for technology or information literacy competencies?
- Has the business community in your area expressed a need for employees with technology skills?
- Do some academic departments already offer technology-related courses?
- Are there faculty committees involved in curriculum development?
- How important is it to your students to develop their technology and information literacy skills?
- How do your alumni feel about an effort to include more technology skills in your institution’s degree programs?

Don’t overlook in your environmental scan academic support units such as the library, student services, and information technology—and even the public relations department, the development office, and institutional research staff. The staff in these units are very likely to have not only an interest in the issue but the expertise to contribute to developing a successful initiative.
Any or all of these groups can be a tremendous ally in developing a unified and coherent institutional approach to improving student technology and information literacy skills. Conversely, they can also be a tremendous roadblock if they feel that their perspectives or interests in the issue are not being addressed by the proposed program. At the very least, your program will be deprived of their potential contributions of time, funding, or expertise if the program coordinators are unaware of their interest in the issue.

For George Mason’s program, the governor and the state legislature (with their concern for workforce development) turned out to be key players in initiating TAC. But the actual design and implementation required many participants within the institution.

Not every group of stakeholders has the same strategic importance, of course, but institutional change being as difficult as it is, one supporter more or one resister less can make a difference in the success of the overall program.

**Engage Your Stakeholders**

Having identified stakeholders or potential stakeholders in the issue of student technology and information literacy skills and their respective levels of strategic importance, you need to engage them appropriately.

At a minimum, you can engage stakeholders by sharing information through a Web site, brochure, e-mail announcement, and the like. At a higher level of engagement, you can actively solicit input on the project through a survey or focus group. For example, in designing TAC, faculty were surveyed quite early in the process to find out the degree to which they were already asking students to use technology in their courses and what kinds of technology they were using. By being able to give a big-picture view of what was already happening, we could show that our proposal aligned with a direction in which faculty were already moving.

We used focus groups both with faculty and members of our local business community to get ideas about exactly what technology
skills students needed to succeed in an academic discipline and in a business environment. The high degree of overlap between the two groups helped faculty recognize that TAC had academic value and was not a vocational sellout to nonacademic concerns.

Other levels of active engagement include membership on a working group or project team, a proposal review board, and an advisory group. Whatever you can do to translate interest to participation and ultimately into ownership benefits the program. If it is seen as (or, in fact, is) the work of only one or two people, it is much more difficult for the program to have long-term staying power, impact, and acceptance.

The TAC program also uses showcases to continue engaging stakeholders. At our annual celebration of student learning, for example, TAC sponsors a prize for the learning project that demonstrates the best incorporation of technology in learning. We also have a prize sponsored by the university libraries for the best original student research to encourage development of information literacy skills. Hundreds of students and faculty visit the event and are impressed with what their colleagues are learning and doing with technology.

**Define Your Terms**

Now, with all these interested parties engaged in your program, there are a lot of ideas floating around about what the program should be. Multiple perspectives and a multitude of ideas can be healthy and helpful at some stages of development, but eventually the participants have to come to consensus on what the program really is and what they are actually buying into.

What would technology integrated into the curriculum look like at your institution? Does it mean every student takes a technology course? That every faculty member uses technology in delivering instruction? That every course requires students to use technology to complete the learning? That some courses or some students or some faculty use technology—and if so, which ones?
Perhaps more basically, what does “technology” encompass? Are you focusing on office applications such as word processing and spreadsheets? Do you also include on-line search and research skills, information literacy skills broadly defined, multimedia skills? What about legal and ethical issues related to technology, such as privacy, security, and copyright? Do you include use of such technology equipment as digital cameras and data projectors, computer operating systems, and programming languages?

None of these possible definitions is necessarily the best for every type of institution. There can be excellent reasons for including or excluding certain features from your institutional approach. But to make the program work, everyone needs to know what is included and what is excluded so that the participants’ energy is focused on the former. The strategies of engagement already mentioned also facilitate definition of terms and buy-in on the program definition.

One cornerstone of TAC is a list of ten technology goals. It took almost a year of collaboration to come up with this list, but once it was established, we could work more easily with many groups to build a program around that set of skills. After three years, we reviewed and revised the list to reflect our changing understanding of the technology goals we wanted our students to achieve. In the newest version (Table 6.1), we have put more emphasis on being able to use representational technologies; consistent with the university’s general education requirements, we have also explicitly identified information literacy skills as part of the desired goals.

Identify Desired Outcomes

Another important clarification for a successful program is identifying desired outcomes. This enables development of guidelines for participants about activities appropriate to the program, and it helps everyone know how you intend to measure the success of the program.

Desired outcomes may include improvement of student technology skills, improved academic performance for students, more student satisfaction with academic programs, greater faculty use of
Table 6.1. Technology Goals for George Mason University Students

<table>
<thead>
<tr>
<th>Students Will Be Able to:</th>
<th>Essential (Examples)</th>
<th>Advanced (Examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engage in electronic collaboration</td>
<td>Send and receive e-mail; understand “netiquette”</td>
<td>Participate in collaborative writing; participate in an electronic conference</td>
</tr>
<tr>
<td>2. Use and create structured electronic documents</td>
<td>Create, format, and edit a document using a word processing program</td>
<td>Use templates, macros, and mail merge to automate repetitious tasks</td>
</tr>
<tr>
<td>3. Do technology-enhanced presentations</td>
<td>Use a presentation software package to create, format, and edit an electronic presentation</td>
<td>Modify standard tools and templates for presentations and develop their own</td>
</tr>
<tr>
<td>4. Use electronic tools for research and evaluation</td>
<td>Understand and apply search strategies appropriate to the Web and on-line databases</td>
<td>Select databases and other resources according to discipline, timeliness, and coverage</td>
</tr>
<tr>
<td>5. Use databases to manage information</td>
<td>Enter data into a preexisting database; conduct simple queries of a database</td>
<td>Set up a relational database of two or three tables; construct a query for a simple relational database</td>
</tr>
<tr>
<td>6. Use spreadsheets to manage information</td>
<td>Enter data into a new or existing spreadsheet; format the layout of a spreadsheet</td>
<td>Use templates and macros to automate repetitious tasks; use statistical, logical, and financial formulas</td>
</tr>
<tr>
<td>7. Use electronic tools for analyzing qualitative and quantitative data</td>
<td>Use a statistical package to enter data, name variables, and define variable values</td>
<td>Perform reliability and validity analyses</td>
</tr>
<tr>
<td>8. Use graphical and multimedia representational technologies</td>
<td>Perform simple manipulations on existing images (download, resize, crop, change format)</td>
<td>Add special effects to an image (color, lighting, reverse, etc.)</td>
</tr>
</tbody>
</table>
technology, better job placement for graduates, or an enhanced reputation for the institution in an area of strategic importance to it. Outcomes can also focus on building a specific partnership with the business community or with another college or university in the region or beyond.

With TAC, George Mason’s primary desired outcome is that every student graduates from the university with a range of technology skills based on the program’s goals. As we revised those technology goals, we added specific performance descriptions so that faculty who were redesigning a course would know what kind of assignment—encompassing both technology fluency and information literacy as appropriate—they would need to build in. Taking the domain of technology fluency as an example, the first definition of the technology goals indicated that graduates would be able to use a spreadsheet; in our revised version, we have specified more exactly what they need to be able to do with a spreadsheet in a beginning or general education course and what they need to be able to do with one in an advanced course in the major. (See Table 6.1 for examples of essential and advanced performance in each goal area.)

<table>
<thead>
<tr>
<th>Students Will Be Able to:</th>
<th>Essential (Examples)</th>
<th>Advanced (Examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Demonstrate familiarity with major legal, ethical, privacy, and security issues in information technology</td>
<td>Understand the basics of copyright and property law as they apply to electronic materials</td>
<td>Understand the ethical issues raised by artificial intelligence, virtual reality, etc.</td>
</tr>
<tr>
<td>10. Have a working knowledge of hardware and software</td>
<td>Perform basic computer operations on at least one computer platform</td>
<td>Install basic peripheral devices (printer, scanner, etc.)</td>
</tr>
</tbody>
</table>
This focus on student achievement and student learning means that TAC does not fund proposals that focus on faculty delivery of instruction. At another institution, delivery of instruction may be an important step in achieving the goals of the program and thus well worth funding.

Identify Resources

Armed with understanding of exactly what you want to achieve, you must find existing resources or develop new ones that can help you meet your institution’s goals. Take another look at that list of stakeholders and see what financial, personnel, or organizational resources they might have that can help build your proposed program. The more your program’s goals align with the goals and interests of potential stakeholders, the more likely they are to share or contribute resources. The availability of resources may determine priorities for implementing the program.

In higher education, leveraging existing resources is an effective, time-honored strategy. If the provost, dean, department chair, chief librarian, head of student services, or development office supports your initiative, then you may be able to take advantage of funding already available for such purposes as curriculum development, faculty and staff development, workforce development, or even classroom renovation. Or you may be able to use these funds to interest a business partner, state or local government, or a foundation in helping implement your project. If funds aren’t available to accomplish everything you want, then target one part of the project whose success is assured and that is highly likely to engender additional funding. In some institutions, technology enhancement may be considered to add value to the educational experience, so students and their parents pay an extra technology fee or buy a computer for student use.

Likewise, the more the program can build on existing staff and existing organizational structures, the easier it is to implement. Is there an organizational or administrative structure in place at your
institution that can manage this program? The goals of the program determine to a certain extent how elaborate a structure you need. If the program involves distributing money, then part of the administration has to be an institutional agent with fiscal authority. If the program is built as part of the regular faculty teaching load and no extra money is involved, then perhaps an existing academic committee structure at the departmental, school or college, or institutional level, as appropriate, can review and approve curricular changes that meet the program goals.

In implementing TAC, George Mason University did create a few new structures (such as hiring a coordinator for the program and bringing together a number of technology support services into one unit), but as much as possible we used the existing resources and organizational structure of the College of Arts and Sciences and the Information Technology unit, the two principle partners in the initiative. When the university libraries began to restructure their instruction program with an information literacy focus, discussion began immediately to see how we could collaborate and help each other achieve mutual goals. When the university added an IT proficiency component to its general education requirements, we worked closely with the universitywide general education committee to make sure that the TAC program was in harmony with general education goals and that the committee was aware of the TAC and library goals in planning its implementation.

Check Your Technology Infrastructure

A program to enhance student technology learning needs technology resources and may flounder if they are not readily available. It can be extremely frustrating to plan new ways to get students and faculty to use technology, only to discover that there are few facilities on campus where they can learn or use these skills, or that the network or server capacity is insufficient to support your plans, or that the technology cannot be accessed when and where it is needed, or that insufficient networked digital scholarly resources are available. It is
wise to start with an understanding of your institution’s existing technology infrastructure and any plans already in place to enhance that infrastructure. Working with your IT staff and librarians, you may be able to target improvements in the areas most important to your program.

Besides looking at the existing structure, you should also take into account whatever increased demand for technology resources your program may generate. Once people start using certain kinds of technology in instruction, more faculty and students want to use them, and expectations grow. Not only do they want to do electronic presentations in every classroom; now they want electronic presentations with audio and video clips accessible over the network. If there’s no possibility that the institution can make that level of technology available, then you must manage expectations or else risk seeing your program labeled as a failure even as it succeeds.

In the case of TAC, we had two major concerns about technology. Faculty wanted to be sure that students would be supported in learning technology skills outside of the classroom and that there would be enough technology-enhanced classrooms to allow faculty and students to demonstrate the targeted technology skills. We dedicated part of the IT staff to the task of mentoring students in technology skills; we focused our equipment funds on making more classroom technology available.

**Build Your Support Team**

New curricula using technology require planning on how you will support the students and the faculty who are to use that technology. Faculty support may include financial incentives or release time as well as student assistants, professional staff trained in instructional design and instructional technology, training classes in instructional technology, librarians to consult regarding research assignments and resources, printed and on-line resource materials,
models of the kind of assignment or evaluation you want them to use, and peer mentors.

Students likewise need a range of support if they are expected to use technology in new ways as part of their learning process. Except for those in some technical disciplines, faculty generally do not want to dedicate class time for teaching technology skills or information literacy. So although they may expect students to be able to create an electronic presentation for class, they are not going to spend class time teaching this application. Likewise, they may not devote instructional time to the process of conducting topical literature research and reporting of findings. Students who need it must be able to get the basics of these skills somewhere else. How will your institution facilitate this? Perhaps you can offer short training sessions through one of the technology-related academic departments. Perhaps you can include this kind of training in instructional sessions held by the library or IT staff.

In the TAC program, we made use of existing instructional support staff (and librarians when appropriate) to work with faculty in developing and implementing course revision proposals. We also developed a new program to make available graduate and undergraduate student assistants for technology projects. In addition, we expanded an existing student technology facility to include a broader range of support and licensed on-line instructional modules for several hundred software applications.

Develop an Assessment Plan

Assessment constitutes a key feature of educational endeavors. In practical terms, it helps you to keep on improving your program and assures your participants and funders that the program is doing what was intended. Therefore, think early on about how you will show that the program is achieving its outcomes.

Can you repurpose data that are already being collected at the institution, as through graduating senior or alumni surveys that ask
about student use of technology during or after their educational experience? Or do you need to collect new sets of data? Perhaps you can work with admissions or student services to collect benchmark information about the technology and associated skills students bring with them to the institution.

It is also important to work with the faculty who are teaching technology-enhanced courses so that they find ways to assess how students’ skills change or how their learning changes as a result of introducing technology or information literacy skills development. You may also want to look at specific tests of competency for all students or a random sample of students to demonstrate the impact of your program.

The organizational structure of the program should include provision for how assessment data are collected and disseminated. Whoever is managing the program has to develop regular reports about how many students and faculty in which areas of the institution participate in the program, and collect data from faculty and other sources about its impact. In addition, thought should be given to how data are applied to improve the program. Who is empowered to make adjustments to it? What are the processes for changing the program?

In our TAC program, we began with a focus on the faculty who were redesigning the curriculum. Proposal guidelines called for inclusion of an assessment component. We didn’t always get one, and we spent a lot of time helping faculty to develop that component, including recruiting the head of institutional assessment to give workshops in assessment strategies. But we kept right on asking for those assessment plans and assessment reports until we got results.

We also developed some programmatic strategies for tracking data, such as a grid of which courses included which technology skills; we published regular reports about the number of students, faculty, and departments participating in the program. The leadership of the program also had operational authority to implement change as a result of assessment information.
Think Programmatically

Curricular change is most effective when it is programmatic rather than episodic. If curricular change is left to each individual faculty member to implement, the institution is unlikely to be in a position to know if the end result matches the original intention. With technology fluency and information literacy skills in particular, it is critical to plan for building a range of skills across a number of courses; this can’t happen unless there is programwide thinking about the connections between one set of skills and other more advanced ones.

Instead of asking individual faculty to think about technology in their individual courses, consider asking all faculty who teach a particular course to set technology or information literacy goals for the course. That way, every student who takes the course, no matter who teaches it, is working toward the same outcomes as the other students are. If the faculty know, for example, that every first-year biology student uses spreadsheets to accomplish certain tasks, then faculty teaching more advanced courses can build on that to help students use spreadsheets for sophisticated data collection and analysis. If use of spreadsheets in the first year is only hit-or-miss, depending on who is teaching the class, then it is difficult for faculty in other courses to build in advanced uses.

Similarly, developing information literacy skills is a gradual and cumulative process. Abilities and skills acquired early on, beginning with introductory or general courses, serve students well in the courses (including capstone) of their chosen major.

George Mason’s TAC program offered extra incentives for group and departmental proposals to encourage the broadest possible collaboration and development across an entire program of study.

If your program is built around a single technology course for all students, then it is important that all faculty be aware of the skills introduced in that course so they can give students additional practice in using the skills in other courses later in their program of study.
If there is no program for ensuring that students use a range of technology and information literacy skills, then they will probably be reintroduced to the same basic skills over and over—never having the opportunity to develop or use more advanced skills at all. In the TAC initiative, for example, we got many proposals for introducing students to Internet research and Web page design, but far fewer that focused on using spreadsheets or electronic presentations, making critical assessment of information and its sources and incorporating selected information in students’ written projects, or understanding legal and ethical issues in technology use. We were able to use our tracking grid and our request for proposals to encourage course development across the whole range of skills that we wanted our students to learn (Agee and Holisky, 2000).

Think Collaboratively

Thinking collaboratively may be the most important strategy in working on your project. Terry O’Banion (1997) sets forth a model that is particularly relevant when applied to curriculum development: “Everyone employed in the learning college will be a learning facilitator, including categories formerly designated administration and support or clerical staff. . . . The goal is to have every employee . . . thinking about how his or her work facilitates the learning process” (p. 58).

If the job of helping students develop interrelated technology fluency and information literacy is left to any one group—faculty, librarians, IT staff, career services—then many opportunities are lost. Understanding and using information and information technology is a multifaceted process that can be facilitated from many perspectives. The more the goal of helping students in that process pervades the institution, the more opportunities students have to learn and hone their skills in these areas. Building as large a community of interest as possible brings more resources to bear and allows them to be used most productively.

If an academic department can share instructional materials, directly or indirectly, then it can avoid duplicating work that is
being done in other departments. For example, if many departments are introducing spreadsheets or electronic presentations into their courses, there is really no need for every one of them to develop independent tutorials, assignments, evaluation instruments, and so forth. The same holds true for courses incorporating assignments related to information literacy. At the least, if faculty members see what other colleagues have prepared, they can build on each other’s work. At best, faculty from several departments might collaborate, assisted by librarians and instructional technologists, in building a library of assignments or tutorials or other instructional resources from which they all can draw.

The TAC program builds on a collaborative relationship between the College of Arts and Sciences and the Information Technology Unit (ITU)—including increasingly the libraries, which are an administrative component of ITU—that involves shared goal setting, shared decisions about priorities and resource allocation, and shared commitment to student learning and success.

Collaborative partnerships can also extend outside the institution—for example, with the business community—in developing internships that help students practice information and technology skills.

Conclusion

No single approach, no single strategy necessarily ensures a successful program that aims to expand and enhance the information literacy and technology fluency of students. A combination of factors, some of which may be unique to a given institution, have to be considered in defining a specific program that helps students at your institution become the information- and technology-savvy citizens and workforce our society needs.

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