The MIT Faculty Newsletter

Teaching Undergraduate Researchers Responsible Research Conduct

Norma McGavern-Norland and Stephanie J. Bird

Undergraduates involved in research are not apt to ponder ethical issues in the practice of research. More likely, the students are so happy to have landed a project that concerns about laboratory practice do not even come to mind. Asking questions – especially when others in the laboratory assume you know the answers, and when you are not eager to demonstrate there are things you do not know – is hardly a top priority. Not to mention the feelings of intimidation that overcome many students in their first one-on-one dealings with faculty. If all this was not enough, there is also the fact that at this stage most ethical concerns can seem very remote ("What do questions about data presentation or research funding have to do with *me?*").

To the extent they do think about it, students assume that they will be treated fairly and that faculty have fully considered the role of the undergraduate student in the lab and the impact of the research experience on other aspects of the student's education and professional development. After all, they are participating in a well thought-out program, developed by people with plenty of experience. For all these reasons, students tend not to reflect on abstract issues and connect them to daily life in the laboratory – until they come across something that sets them to wondering.

TEACH TALK

Teaching Teamwork Skills
Part 2
Lori Breslow

The underlying premise behind last issue's "Teach Talk," and the point that provides the underpinning for this column as well, is that we humans don't seem to come programmed with an inborn ability to work together productively and well. Some people, of course, are more adept at social interaction than others, and can use that intelligence to mobilize a group to accomplish a task at hand. But I have observed among my own students that even those who are the most outgoing and personable aren't necessarily well versed in the skills they need to function in a work-oriented team.

If we believe we have a responsibility to make sure our students leave MIT not only with analytical and technical skills, but with the so-called soft skills as well, then we have a responsibility to provide opportunities for the students to master those skills. (I do understand that there are those who would argue that teaching teamwork, for example, is not part of this institution's mandate, but that is not what we hear from potential employers or many of our own alumni, for that matter.) The bad news is that we can't fulfill that responsibility simply by putting students in groups and telling them to work together; the good news is that with attention to a few guidelines and best practices we can go a long way to helping students strengthen these basic abilities.

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From The Faculty Chair

CUP to Review Curriculum
Arts and Sciences Degree Considered

Lotte Bailyn

Education in the new millennium – what should it look like? In many respects, MIT is uniquely positioned to provide students with this education, since it combines a comprehensive grounding in science with a wide selection of subjects in the arts, humanities, and social sciences. This combination could be said to be the best liberal arts education for the technological age. But is it? The Task Force on Student Life and Learning has been debating this question, and the Committee on the Undergraduate Program is planning this spring to review our curriculum in light of the Task Force's recommendations.

We already know that some things are missing. In the area of writing and communication in general, we know that our graduates are not up to par. And we often wonder whether they are having the impact in the world that their abilities should permit them to have. We further know that there is an increasing variety in our students' career paths – many more than ever before head for careers that do not directly use their technical knowledge – and it is not clear that our current curriculum is fully meeting their needs.

In response to some of these concerns, there has been talk of a new option in the undergraduate program, which might be called a Bachelor of Arts and Sciences. This option would combine a sub-major in Science, Engineering, or Math, with a supra-minor in the Arts, Humanities, or Social Sciences – nine subjects in each of two parallel streams. This is not a new idea. More than a decade ago, there were a number of reports that dealt with "an integrated curriculum in the liberal arts" or a "dual major" combining a major in engineering or science with one in humanities and social science. And John Burchard (the first dean of the School of Humanities and Social Science) is reported to have said that a tree (of science) with branches (of humanities) is not a good enough education. Instead, he proposed a "two-tree" solution. None of these previous attempts were instituted. But given the changes that we are seeing in the plans of our students, and in the needs of this more complicated world, perhaps it is time once again to consider this plan seriously.

The thought behind this new degree is to provide students with a fairly deep mastery of a technical field and combine it with an equally deep mastery of a field that is based on a different way of understanding the world and acquiring knowledge about it. It is not meant to substitute for the current curriculum. There will still be need for dedicated scientists and accredited engineers. Probably no more than 10-20 percent of the student body would opt to take this degree. And yet, it may have an impact on the Institute and its alumni that transcends the people actually involved. It might increase the level of engagement in humanities courses, which would benefit all students taking them. And it might send graduates out into the world that have the technical analytic abilities associated with a traditional MIT education combined with some of the human and social competencies now felt to be lacking.

The Faculty Policy Committee has established a sub-committee to pursue this idea. It is chaired by Sam Allen, of the Materials Science and Engineering Department, and includes faculty members Jeanne Bamberger (Music and Theater Arts), Isabelle De Courtivron (Foreign Languages and Literature), Paul Schechter (Physics), and Jeff Shapiro (Electrical Engineering and Computer Science). Dedric Carter (senior in Electrical Engineering and Computer Science) and a representative of the Dean's Office are also members. Faculty are encouraged to send reactions to the Committee. ✤

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Letters

To The Faculty Newsletter:

On the Technology in the Classroom Survey [*Faculty Newsletter*, Vol. X, No. 4] – the results are predictable.

Blackboards and chalk allow for:

• Passion!: You can pound the board for emphasis! The best teachers have passion.

• Human Interaction!: As a lecturer I can "sculpt" my lecture with different width lines and color of chalk.

• Infinite Room!: I have a *huge* playing field.

• Reliability!: Ever see a blackboard light go out? You can ALWAYS get chalk or erasers from next door!

Alexander Slocum
Assoc. Prof. of Mechanical Engineering

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Many questions, many kinds of answers

"Doesn't the data belong to me, since I'm the one who collected it?" "I think I should be included as an author." "I like to work late at night so I need a key to the lab." It is not surprising that students have such notions. Research experience is learning by doing, and learning laboratory protocols and rules of conduct, like learning research skills, is picked up along the way. It is not even possible to answer every potential question; there are just too many pieces of information and too many kinds of situations. Arguably, the best way of learning appropriate behavior is *in situ*. Yet we owe our students at least some amount of active guidance and information. Unlike what happens in structured learning situations, instructions for research are not generally handed out. Students need to be aware that problems, including ethical problems, can arise, and they need to be alert to ambiguities. Young researchers, even beginners, may have to make judgments, and need to be reminded to ask questions of their research supervisors whenever they are in doubt.

The Undergraduate Research Opportunities Program (UROP) has existed at MIT for well over 25 years. Of our 4,400 undergraduates, all but 20 percent will have done UROP work before graduation – a lot of UROPers over the years, working in every imaginable area, from the sciences and engineering disciplines to the arts and social sciences. Along the way they will certainly have learned something about basic laboratory skills, how to search the literature, how to keep a laboratory notebook, how to analyze data, make presentations, troubleshoot equipment, network with other researchers, and so forth. Those who do more than one UROP project (two is typical) will have sampled the methodologies and protocols of different laboratories and even different disciplines.

> **Problems often arise as the result of a simple lack of information. A UROP staff member remembers a dispute between an undergraduate researcher and a graduate student colleague. The undergraduate student was leaving the project and took his lab notebook with him. His supervisor and the graduate student were seriously worried about the missing notebook. The student would not give it back. "It's *my* lab notebook," he said. He did not realize – and no one had told him – that although he could make a copy, lab notebooks belong to the project.**

What the students learn about ethical practice in research is far less certain. Students who participated in UROP "a lot," according to a 1994 survey of seniors, said that their writing skills, public speaking ability, academic self-confidence, and intellectual curiosity had improved significantly, more than among students who had not done undergraduate research. Well and good. But only a third of all the seniors said they felt that their knowledge and abilities regarding "awareness of ethical issues" had improved. Perhaps it is because students are busy doing: learning the details of research techniques and getting the all-important hands-on experience. But we know there is much more to becoming a successful science professional than learning scientific principles and laboratory techniques. It set us thinking about what students expect to learn in their research experience, what we expect of them, and how we might help develop a closer match between the two. The question is, how can we best educate undergraduate researchers about professional standards and ethical values and the conventions of research practice?

Finding answers

Sometimes, of course, answers to questions about how to behave in research really do come from experience, from turning to one's own conscience. A few years ago, a student doing a UROP project found himself in an interesting situation, and described it in a project evaluation. "At one point," he said, "my program was working according to prediction, but as I was checking over some old code, I noticed that I had made a

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programming error and my program was not evaluating the correct function, although it was giving great results. I thought to myself, I could just not say anything and let it go, and it would work fine. Or I could say something, and the program would not work anymore." In this case, the answer came from the student himself. "As I thought it over," he went on, "I realized that this wasn't a game or a problem set where you can cover up your path as long as the answer works in the end. Here you are potentially dealing with major aspects of other people's lives, so everything should be right. Basic research is not something to fudge."

Not all answers can come from self-questioning. Problems often arise as the result of a simple lack of information. A UROP staff member remembers a dispute between an undergraduate researcher and a graduate student colleague. The undergraduate student was leaving the project and took his lab notebook with him. His supervisor and the graduate student were seriously worried about the missing notebook. The student would not give it back. "It's *my* lab notebook," he said. He did not realize – and no one had told him – that although he could make a copy, lab notebooks belong to the project. This misunderstanding is only a few steps removed from the student in a course with a lab component who regularly erased data she was taking from experiments and rewrote the data on clean pages because it "looked neater" that way. Clear guidelines to beginning researchers, explanations by supervisors about research protocols, and even a little bit of experience can clear the air about misunderstandings.

Make sure, we consistently tell students, that before you start you know what your research is all about. What, specifically, do you think you're going to do? How will you go about it? How does this work relate to other work in the field? Asking questions can be hard, so it helps that students are required to write up their research plan before they can earn credit or pay, and that this description has to be approved by the faculty supervisor and the department's UROP coordinator. If students are not able to describe their planned research, we expect them to ask questions until they do know enough to convince us that they know what they are doing. Students working for pay will have to find out which charges to a research account are allowable, and which are not. They will have to find out who assumes responsibility for their supervision when their supervisor is away, and who signs their weekly timecard.

Soon after starting, new researchers will have to find out what the conventions or rules are in their field of research, and how they might be different from rules they have experienced in other laboratories or disciplines. Some questions have clearer answers than others. Information and resources regarding standard practices and regulations governing patent rights, copyrights, the care of laboratory animals, and the use of humans as experimental subjects can be looked up in our undergraduate research directory. The more complex questions are tied to situations beginners have not yet experienced. Issues like criteria for authorship, techniques for data selection and presentation, and proper

acknowledgment of sources sometimes present no obvious resolution. Where there is a range of accepted practices within the discipline and there is no single correct approach, helping students to figure out the answers to these kinds of problems may be a real challenge.

Bringing together issues and situations

There are several approaches we can take to promote discussion and facilitate the education of undergraduates about conventions and professional standards of behavior. First, UROP has a recently revised informational brochure called *What to Expect, and What's Expected of You?* that identifies issues and aspects of research practice about which students may want or need specific information. It also provides suggestions about how they might find this information. The brochure will be given to all beginning UROPers. Second, this IAP we held the first of what we hope will be a series of facilitated discussions between faculty and students about responsible research conduct. Our January Mentoring Program which brings together experienced UROPers and beginning UROP students also offers an opportunity to introduce new UROPers to issues of research practice.

Our goals are to: (1) increase awareness and knowledge of professional standards; (2) increase awareness of the ethical dimensions of science; (3) provide individuals with experience in making and defending decisions about ethical issues that arise in research; and (4) teach individuals when and how to gather resources for making decisions.

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During IAP in January, UROP and the Provost's Office jointly sponsored an event for UROP students and faculty on the general topic of responsible behavior in research with a focus on issues most relevant to undergraduate researchers. A short scenario based on situations and issues that researchers might actually experience or witness was used to catalyze discussion.

Ownership of data. In our UROP brochure we tell students to find out early in their project who will retain custody of primary, original data, gathered in the field or in the laboratory. We tell them never to destroy primary, original data, no matter how rough its form, in part because colleagues and other readers of published results may raise questions that can only be answered by referring to such data. Students should also be aware that "ownership" can be an ambiguous term. How free can one be discussing someone else's research?

A scenario called *Busman's Holiday* [Prepared by Eve K. Nichols and Stephanie J. Bird] describes the following situation: two students, John and Bill, friends in college and now graduate students on two different coasts, meet at a Christmas party in their home town. They exchange stories about their college experiences and the research projects they are working on at their respective schools. It turns out that John is working in a research area closely related to that of a lab in the same department Bill is in. Fascinated by this coincidence they start comparing notes, and end up talking about approaches scientists in each of the labs are taking. After John describes some new work in his laboratory, Bill

starts to describe the latest development he has heard about when he suddenly remembers how sensitive the other researcher is about sharing his data, recalling how he once said he was afraid of being "scooped." Bill says, "I don't know how he'd feel about my talking about this." It's an awkward moment. John changes the subject. Questions remain for Bill. Did

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he do something he shouldn't have done? Should he mention anything about his conversation with his friend John, and what the other lab is doing when he gets back to his research group?

Acknowledgment of sources. Undergraduates struggle with issues that relate to acknowledgment of sources. Many students' sense of what it means to give credit to others begins and ends with citing a direct quotation. Proper acknowledgment in research, we remind students, extends to articles, books, and conversation. We suggest they ask their research supervisors about quoting and paraphrasing sources of information. It is helpful for students to understand that faculty, too, face acknowledgment issues.

A second scenario [*Tenure Track* scenario © Whitehead Institute for Biomedical Research, prepared by Eve K. Nichols, with assistance from Profs. Gerald R. Fink, Lawrence E. Susskind, and Robert Weinberg] lets students hear how faculty might discuss an important issue: Assistant Professor Dick Matthews is close to receiving tenure. In a discussion with his department head he hears his recent article praised, "You took a problem that has plagued the field for 10 years and turned it around so that everyone can see the solution." He responds, "It means a lot to hear you say that. I'm not sure where the idea came from myself...I started doodling and suddenly I knew what the problem was. When I went back to the bench the answer was clear." Is that *really* what happened? Later, Matthews' graduate student gives him the name of a Canadian journal article that seems, she says, "vaguely related" to Matthews' research. Matthews reads it and is shocked. It lays out the ideas that appear in his paper. Talking about this

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with an assistant professor friend, he tells him he had met the author at a symposium two years earlier, but neither he nor anyone in the lab normally reads this particular journal so he never saw the article. He feels sure he developed his ideas independently, but fears if he withdraws his paper now it will jeopardize the tenure decision. His friend suggests that instead of withdrawing the paper he acknowledge the author's work. The next day, when his graduate student asks if he had time to read the article, Matthews replies, "No, it probably didn't relate much to what we're doing." The scenario sets the stage for a discussion of where ideas come from, intellectual property issues, professional relationships, and aspects of mentorship.

Authorship. Quite a few MIT undergraduates end up with their names on published papers, some even as first authors. Since students who have been working for a year or more on a single research project know that co-authorship might be possible, they have many questions about authorship criteria. Undergraduate contributions to a piece of work are weighed by the same standard as any other contribution from the research group. Not all undergraduates understand that, however, and some worry they are missing out on being a co-author not because their contribution was minor, but because they are undergraduates. UROP suggests they find out about co-authorship criteria in their research group. If they are going to be writing a paper that has multiple authors, they need to verify which part of the manuscript falls within their jurisdiction, and which author is designated as the party

responsible for the entire manuscript. Given the wide range of accepted practices regarding authorship within and across disciplines, we do not attempt to explain how authorship operates, however.

In another scenario [*Late One Night* scenario ©Whitehead Institute for Biomedical Research, prepared by Eve K. Nichols with assistance from Profs. Gerald R. Fink, Lawrence E. Susskind, and Robert Weinberg] Sandra Dunn, a post-doc working with a research group that includes Professor Barbara Steel and graduate student John Palant, has told John that she had an idea that might help him in his work to find the co-activator for his DNA binding protein, his thesis project. The next day at a group meeting John asks her what she has found, but she responds that she had been wrong, and he should forget about it.

Sandra does not appear in the lab for several days. When she does appear the following week in Professor Steel's office she explains she has solved John's problem and needs just one more experiment to confirm the results. She has also drafted two papers. She put John's name on the first because she began with his technique. But his name is not on the second. She explains, "The second paper on the co-activator and its implications for all regulation is mine." Professor Steel suggests that she reconsider. "I like to think we all work together in this lab." Then she adds, "Have you shown these papers to John yet?" "No," Sandra answers, "I thought I'd present them at group meeting tomorrow. What do you think?" Discussion of this scenario provides an opportunity to consider to what extent students would do things

differently if they, like Sandra, had solved John's problem, and to explore the criteria for (and responsibilities of) authorship, laboratory relationships, professional advancement, mentorship, and other relevant topics.

Taking it from here

No single discussion or brochure can in itself alter undergraduates' understanding of research practice. What we can do is raise the general level of awareness, at least for a time. In the process of developing the *What to Expect* brochure, we realized that we have a responsibility to teach our students about ethical practice in the course of monitoring UROP. Several academic departments and individual faculty offer special seminars to prepare students for research. These are excellent opportunities to make students aware that there is more to learn about research than technical skills. In the long term we can provide information and offer occasional forums to discuss research practice. Faculty need to be reminded from time to time that young researchers have gaps in knowledge and experience. We must encourage undergraduates to ask questions, and help them sort out misunderstandings. Sometimes we have to remind them that one of the most valuable experiences in their education can be learning from their mistakes.✣

Research in Progress

Simulating Commercial Power Reactor Coolant Environments in the MITR-II Research Reactor

Gordon Kohse

Although nuclear power accounts for about 20% of electric power generation in the United States (second only to coal), no new nuclear plants have been built or ordered for a considerable time. Several aging or troubled plants have been shut down because the economic case for continued operation could not be made. Adding to the uncertain future for nuclear power is the controversial but accelerating movement toward deregulation of the electric utility industry. In this climate, it is imperative that nuclear utilities maximize the availability and efficiency of their plants while continuing to satisfy regulatory requirements. To achieve these goals a variety of problems must be addressed, a number of which are related to corrosion and chemistry in the primary coolant system.

My research over the past 10 years has addressed such problems through the design, construction, and operation of a set of unique facilities that operate in the 5MW MITR-II research reactor at MIT's Nuclear Reactor Laboratory (NRL). The technical challenge of constructing accurate analogues of power reactor coolant circuits arises from the low temperature and pressure at which the MITR-II operates, and from the limited physical space available in core. The incentive to perform such experiments at a research reactor, rather than in a commercial plant, arises from the accessibility of the facilities for operation and measurement, the broad parameter range that can be investigated, and very large cost savings over typical in-plant pilot programs. Despite the large absolute power disparity between the MITR-II and commercial nuclear power plants, the power density and irradiation environments are remarkably similar. It is therefore possible to study aspects of the

primary coolant system where radiation effects on the cooling water or the materials of construction are important.

One such aspect is the problem of radioactive corrosion product transport. In the light water cooled reactors (LWRs) used by American nuclear utilities, there is a small but significant content of radioactive material carried in the coolant. This inventory arises from release of fission products from fuel elements, from activation of in-core materials such as the fuel cladding and structural components, and principally from activation of material corroded or eroded from surfaces outside the core and deposited in-core by the flowing coolant. Deposition of radioactive materials outside the core is a significant source of worker radiation exposure during plant refueling and maintenance.

The first LWR simulation facility installed at the MITR-II was used to demonstrate that careful control of coolant pH is a useful strategy for reducing the out-of-core activity levels. The facility is a one-third-scale reproduction of a single unit flow cell (one steam generator tube plus one inter-fuel-pin channel) in a commercial pressurized water reactor (PWR). It is unique in that it closely simulates most of the parameters thought to be important in corrosion product transport, including coolant velocities, heat fluxes in in-core and out-of-core components, and the surface area ratios of the principal primary circuit materials. The small size and low cost of the wetted portions of the experiment make possible the unusual strategy of complete replacement of these surfaces for each run at a specific coolant condition, in contrast to the more usual technique of installing and replacing small sample coupons. The MIT approach allows complete post-irradiation radioactive and chemical

product inventory and ensures that there is no "cross-talk" between the runs at different conditions.

More recently, facilities using passively and actively loaded mechanical test specimens to study environmentally assisted cracking (EAC) have been operated in the MITR-II. Various types of EAC are of concern to nuclear power plant operators. Our studies have focused on irradiation assisted stress corrosion cracking, in which cumulative irradiation effects on in-core components as well as instantaneous radiation-induced water chemistry effects are known to be important. The actively loaded system, in particular, exploits the unusual accessibility of the MITR-II with the installation of a standard servo-mechanical test machine on the reactor tank lid. The system permits one or more specimens to be tested at a controlled load in the core of the reactor under coolant conditions similar to those found in LWRs. One of the goals of this research is to separate the effects of cumulative and instantaneous irradiation to better understand the significance of data generated by testing irradiated materials in an out-of-core environment.

These examples (of two of the five major loops) illustrate the important role of research reactor experiments in areas where irradiation effects are integral to the problem being studied. Well-designed experiments permit relatively low cost investigation of pressing reactor problems and the freedom to increase our understanding of important underlying mechanisms. Results can be applied to the continued efficient and safe operation of the installed base of nuclear power plants and thereby contribute to a stable and responsible system of electric power generation. ✤

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Who Made That Rule, Anyhow?

John Hildebidle

I think it finally dawned on me a few years ago, during an IAP session about "academic dishonesty" that the estimable Travis Merritt talked me into being part of. The message was clear – everyone in the room, faculty, post-docs, undergraduates, you name it – were convinced that there was an Eleventh Commandment (or was it just the Prime Algorithm?) on those stone tablets Moses lugged down the mountain: *Someone Is Bound To Fail.*

No matter the subject, no matter the group of students, no matter whether they were self-selecting or coerced by one or another of the General Institute Requirements, given 13 weeks and all the equipment imaginable, plus TAs and Athena besides, still we could not bring the whole lot of them up to some definable minimally-acceptable level.

"Well," I've been told, by sager heads, "there are always a few who just don't make the effort." Sad, but true – in my decade and a half here at MIT, I've run into those derelicts, who can't manage to get themselves to class, always manage not to turn in assigned work, and so on. One wonders why on earth they came in the first place – to spend so much money to do nothing useful. It's comparable to the dolts who pay the price of a ticket to Fenway and of the beer they sell there, as a way to drink themselves stuporous.

But still, can there be *that* many of such folk wandering the Infinite Corridor? I find it hard, no impossible, to believe. Which takes me back to the initial puzzle yet once more. And the puzzle grows, as Lewis Carroll so deftly put it, "curioser and curioser" given that we like to pretend that we are dealing with the brightest people of their age in the known universe. SAT scores, high school grades – no matter what the measure, our students are off the charts. And still they fail.

Or is it that *we* fail? That our pedagogy is so inept, and our curriculum so ill-

formed, that they just won't do the job? A few weeks ago, at a day-long "retreat" organized by the CUP to ponder the nature of MIT's program, I expressed my bafflement to one of my colleagues. She rejected my premises (note the pronoun). "They're not the brightest in the world. Not any more." (Someone had just remarked that the failure rate in one or another of the mobbed freshman requirement courses hadn't changed appreciably as long as records stretch back.) The reasons. Affirmative action of course, both on matters of ethnicity and gender.

Now *that* strikes me as a really dangerous notion. "Blame the women" – how convenient, how tidy! My own teaching experience stretches back to a public junior high school, where each year we had a sturdy quotient of those students we called LBD – "lovable, but dumb." My favorite – I will protect his privacy by suppressing his name – was one I dubbed "the Mad Cabbage" in honor of the way he played linebacker on a football team I coached. All of which is a roundabout way of saying I have met and worked with truly limited intelligences, and I don't find them in my classes here at the Institute.

It seems to me sometimes we suffer from a radical confusion about our enterprise. Are we *teachers* or *winnowers*? That is, do we undertake to communicate learning to a body of young people, with rigor and high expectations of course but

with pedagogical effect, as well; or do we undertake to sort out, from an otherwise hard-to-differentiate group of young people whom the rest of the world sees as more or less equivalent, those who are truly excellent from those who are merely extremely accomplished?

In the one case, we should take pride in the relatively high rate of accomplishment of our students. I know that my *alma mater*, that Liberal Arts college just up the Red Line, makes a great deal of noise about its graduation rate, and likes to brag it's hard to get into Harvard, but (once you're in) it's hard to get out again without a BA. MIT seems less prone to that particular variety of self-congratulation, but we make a point of parading in all their vast numbers those who have stayed the course, each Commencement Day. But if our real work is to sort out, should we not find that parade a point of shame – a sign we haven't been tough enough, demanding enough, strict enough? A chilling thought, I grant you; maybe just a passing nightmare, in the long dark nights of late winter.

Still, I remain, stubbornly, puzzled by the persistence of failure among our students. And I remain convinced that it is not so much that *they* are failing as that *we* are failing them. I only wish I had the key to some reformist solution. I've tried to come up with one, but alas, I've failed.✥
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Freshman Advising Seminars
Seek Faculty Advisors

Stephen Benton

Freshman Advising Seminars have become MIT's second most successful innovation in undergraduate education after UROP. Yet many faculty know very little about the advising seminars and certainly do not know that the program struggles each year to find enough faculty to lead them. The gentle-but-persistent recruiting of Professor Emeritus Travis Merritt has been vital to the success of this program for the last 14 years. With his retirement, the program is in danger of losing momentum.

Like UROP, Freshman Advising Seminars bring faculty and students together in a close working relationship – this one formed in the very first weeks of the freshman year. Freshman Advising Seminars gather a group of eight freshmen and one faculty member in weekly meetings during the fall to discuss a nominal academic topic. The style is meant to be that of a seminar, rather than a lecture, often with a hands-on atmosphere. Seminars frequently launch a student's interest in research, and even a career in a particular field, although several are deliberately nonprofessional in nature. Fall 1997 seminar activities included, among many others, building an electric go-kart, using optical physics to model and animate commercial renderings, and measuring pollutants in Boston Harbor. One seminar even built "snow clearing aids for the less athletic."

Students receive six units of credit for their participation in the seminars and are expected to do a certain amount of reading and some presentations. While the academic work takes up most of the seminar time, about a third of it is devoted to group advising about general issues such as academic matters and adjustment to MIT. Upperclass associate advisors help with all aspects of the seminar.

Faculty report that seminars are often among their most satisfying interactions with undergraduates. But these seminars are generally volunteered on top of our usual academic loads and have been minimally valued as part of our academic mission by many departments. This has often made it difficult to recruit enough faculty participation in our busy world. We are working hard to attract wider interest in Freshman Advising Seminars, as well as a wider appreciation of their accomplishments.

In a wonderful gesture, the President and Provost have offered us a Scholarly Allowance of $1500 per seminar as an indication of their genuine appreciation of the program! We hope their recognition of the importance of leading a seminar will help convince you that this activity is viewed as a serious component of our educational mission.

About 800-900 freshmen hope for a Freshman Advising Seminar each year. To accommodate such a demand from the Class of 2002, we will need 125 seminars. Because we have only 80 commitments so far, there is some urgency in my request that you consider giving a Freshman Advising Seminar this fall. You will be joining a dedicated group of faculty who have found this style of interaction with our newest students challenging and uniquely rewarding.

If you might be interested in offering a Freshman Advising Seminar or would like more information about the program, please call Donna Friedman or Bonnie Walters (x3-6771; friedman@mit.edu; bon@mit.edu). Or e-mail me at sab@mit.edu.✤

A Note to Instructors

Please note the following information concerning the Fall 1998 term.

Fall Term: Number of Class Days (Wednesday, Sept. 9 – Thursday Dec. 10) = 63 days.

13 Mondays; 12 Tuesdays; 13 Wednesdays; 13 Thursdays; 12 Fridays

September	7	Monday	Labor Day
	8	Tuesday	Registration Day
	9	Wednesday	First Day of Classes
October	12	Monday	Columbus Day – no classes
	13	Tuesday	MONDAY SCHEDULE OF CLASSES TO BE HELD
November	11	Wednesday	Veterans Day – no classes
	26,27	Thurs-Fri	Thanksgiving Vacation
December	10	Thursday	Last Day of Classes
	14-18	Mon-Fri	Final Exams

Freshman Advising Seminars
By School and Department/Section Sponsorship*
1986-1997

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Totals
ENGNRG	**1**	**14**	**26**	**14**	**25**	**32**	**53**	**49**	**49**	**57**	**46**	**39**	**405**
1	0	2	1	0	3	3	6	4	4	5	5	3	36
2	0	3	6	3	5	2	4	7	8	11	6	3	58
3	1	1	5	4	3	4	4	6	5	7	6	8	54
6	0	2	4	3	6	7	15	13	11	11	11	7	90
10	0	0	1	1	1	2	2	2	3	3	1	1	17
13	0	2	3	1	0	3	5	4	4	6	4	6	38
16	0	3	3	1	3	7	10	8	8	9	6	6	64
22	0	1	3	1	4	4	7	5	6	5	7	5	48
SCIENCE	**2**	**11**	**22**	**23**	**24**	**23**	**29**	**33**	**34**	**35**	**39**	**36**	**311**
5	0	1	1	3	3	4	4	4	4	2	5	3	34
7	1	2	6	6	4	4	6	6	7	9	7	7	65
8	0	2	4	2	3	5	5	5	3	3	5	6	43
9	0	1	5	6	4	1	4	4	2	3	4	2	36
12	1	5	3	4	8	7	7	11	16	15	17	15	109
18	0	0	3	2	2	2	3	3	2	3	1	3	24
H & SS	**3**	**6**	**7**	**7**	**6**	**16**	**20**	**16**	**19**	**11**	**9**	**15**	**135**
14	0	0	0	0	0	2	1	1	1	1	0	1	7
17	1	1	2	1	0	2	3	4	3	3	1	3	24
21-A	0	0	0	0	0	0	0	0	0	0	0	0	0
21-F	0	0	0	0	0	0	1	1	0	0	1	0	3
21-H	0	2	3	2	2	4	4	4	3	4	1	3	32
21-L	1	1	1	2	2	2	2	2	6	1	0	2	22
21-M	0	0	0	1	2	2	3	3	5	1	4	2	23
21-W	1	2	0	0	0	2	3	1	0	0	1	0	10
STS	0	0	1	1	0	0	1	0	1	1	1	4	10
24	0	0	0	0	0	2	2	0	0	0	0	0	4
ARCH/PLNG	**0**	**0**	**5**	**4**	**6**	**14**	**9**	**7**	**8**	**11**	**13**	**14**	**91**
4	0	0	2	3	5	8	7	2	1	4	3	4	39
11	0	0	3	1	1	6	2	2	5	5	5	6	30
MAS								3	2	2	5	4	16
MANG.	**2**	**1**	**1**	**1**	**2**	**4**	**5**	**3**	**7**	**5**	**5**	**4**	**40**
15	2	1	1	1	2	4	5	3	7	5	5	4	40
WHITAKER COLL.	**0**	**0**	**3**	**2**	**1**	**3**	**4**	**3**	**2**	**1**	**1**	**2**	**22**
20/Div of Tox	0	0	2	1	1	2	2	3	2	0	1	2	16
[HST]	0	0	1	1	0	1	2	0	0	1	0	0	6
OTHER	**0**	**0**	**1**	**1**	**1**	**1**	**2**	**9**	**13**	**13**	**15**	**11**	**67**
Edgerton Ctr	-	-	-	-	-	-	-	2	2	4		3	11
Independent**	0	0	1	1	1	1	2	7	11	9	15	8	56
Totals	**8**	**32**	**65**	**52**	**65**	**93**	**122**	**120**	**132**	**133**	**128**	**121**	**1071**

*All seminars receive departmental or School approval.
**Do not bear a department number.

Teaching Teamwork Skills
Breslow, from Page 1

In the last "Teach Talk," I wrote about how to create student teams, provide training in teamwork skills within the classroom setting, coach the teaching staff to work with student groups, structure assignments, and give feedback. In this column, I want to discuss adopting the role of coach and guide, communicating the message that teamwork is important, asking students to reflect on how successfully their group is functioning, and establishing grading policies.

More Guidelines for Using Student Teams

Ensuring that the teamwork experience is a positive one that promotes learning means that instructors must pay attention to several crucial elements in organizing the course, in using class time, in creating assignments, in grading, and in structuring their roles in and their relationship to the class. Following are guidelines on each of these elements:

Adopt the role of coach, guide, facilitator, and cheerleader. When student groups are working together in class (and, as I wrote in the last issue of "Teach Talk," providing class time for group work is extremely important) the instructor must move from being at the center of attention in the classroom (either as lecturer or as discussion leader) to being an adjunct to the action.

How much should you become involved with groups of students as they work together in class? That depends on the assignment the group is working on, the level of proficiency the students have demonstrated in teamwork, and your own teaching style. My tendency is to let student groups work together for a while (perhaps 15 minutes) and then to move among them. (I do warn the class beforehand that I'm going to be "eavesdropping" on their activities.) I find that students need help on everything from keeping on task, to problem solving, to decision making. They even need coaching in something as seemingly simple as getting to know one another. During the first semester I was involved with 2.002, I noticed when we first put the students together in their groups, they didn't introduce themselves to one another. So the

> It is also necessary to make yourself available to student groups outside of class for consultations and "counseling." Although mediating group conflicts can be challenging, students need a safety valve in case things begin to fall apart. Almost always the trouble revolves around some team members doing more than their fair share of the work.

second semester, before we let team members meet for the first time, I announced they had to tell one another their names!

It is also necessary to make yourself available to student groups outside of class for consultations and "counseling." Although mediating group conflicts can be challenging, students need a safety valve in case things begin to fall apart. Almost always the trouble revolves around some team members doing more than their fair share of the work. In most cases, the best course of action is to bring the students together, let each air his/her perspective, and help members of the group listen to one another. Sometimes, team members can draw up a contract explicitly stating what each member will do on assignments for the remainder of the semester. Some follow-up with team members to make sure problems are under control is advisable.

Communicate the message that improving teamwork skills is important. Students need to know that learning teamwork skills is a stated objective of the course; that working in teams isn't simply a way to complete assignments. This message should be written into the syllabus, explicitly stated sometime in the first couple of classes, and re-emphasized throughout the semester. One way to put some "teeth" into this policy is to include graded assignments on teamwork skills. For example, in 2.002 we gave out a "problem set" on teamwork, which was a series of short essays based on readings in teamwork that the students had to do.

Provide a mechanism for reflection on the group process. Students can also be asked to keep journals that focus on team dynamics and processes. (These should be collected and feedback given either in the form of grades or comments.)

More often than not, students don't know what to pay attention to if they're being asked to observe the *process* of team dynamics rather than to describe the task(s) the team is involved in. Entries in the journal – or discussions

Teaching Teamwork Skills
Breslow, from preceding page

on teamwork if that is the mechanism you choose – shouldn't be about the work that is being done (e.g., what happened in the lab, what facts were discovered when doing research for the group paper), but instead should comment on how the team is functioning. Students can be given a list of criteria or questions that look at team interactions. Topics could include, for instance:

• *Communication patterns*: Who talks the most? The least? How does the team ensure that all voices are heard? Do people interrupt one another? Does anyone mind interruptions? How is the agenda set for what topics are discussed? Can new topics be introduced in the course of the discussion?

• *Intercultural communication and diversity*: If team members have different cultural backgrounds, do their backgrounds contribute to differences in their communication style? Have you needed to accommodate those differences? If so, how have you done that? If you need to be more sensitive to differences in the future, how will you accomplish that?

• *Task assignments*: How does the team decide what needs to be done? Once tasks are identified, how are they divided up? How are deadlines determined? What happens if someone doesn't meet a deadline?

• *Leadership and other roles*: How is a leader or facilitator of the team determined? [Note: Often students are either required or encouraged to rotate the role of facilitator among group members.] What other roles do you find team members playing?

• *Problem solving*: How has the group gone about solving problems (both related to tasks and to the maintenance of the group)? What has been effective about the processes

you have used? How can you improve on your ability to solve problems?

• *Decision making:* How are decisions made in your group? By consensus? Through voting? What happens if a group member is unhappy or uncomfortable with a decision the group has made?

• *Conflict Resolution*: Have you had a serious conflict in your group? Assuming you resolved it, how did you do so? If you haven't worked it out, how is it affecting your ability to get work done? What will you do to resolve the conflict?

The important point here is to get students to reflect on their behavior as a member of a team, to understand how they are or are not contributing to the operation of the group, and to think about how they can improve group interactions.

Set a clear standard about grading. Grading teamwork is a thorny issue. Should assignments be given one group grade? If not, how do you differentiate between the performance of group members? Should students have any input into the grades of fellow team members? If so, how much?

David Johnson, Roger Johnson, and Karl Smith, three of the leading authorities on collaborative learning, maintain that for groups to be successful, the team must have "positive interdependence": that is, they write, "students [must] believe that they sink or swim together." (*Cooperative Learning*, p. 16) Positive interdependence must be built into the tasks and assignments teams are asked to do, but then giving one group grade on one or more assignments is a way to reinforce the message.

On the other hand, the authors also make it clear that individual accountability, "which exists when the performance of each student is

assessed," (p. 19) is an essential element of effective teamwork. Again, this requirement is met not only in grading policies, but in the assignments made. So students must show that they can work together, and they must demonstrate their mastery of the skills or materials they are being asked to learn. The ways assignments are graded needs to reflect both of these aspects of student performance.

There are mixed feelings on whether or not it is a good idea to solicit student opinion on individual member's efforts. Some instructors welcome the feedback and believe it is another way of providing a safety valve if the workload has become seriously unbalanced. Others feel that, at best, student feedback doesn't accurately reveal what has transpired in the group, and, at worst, can become a mechanism for venting negative feelings or revenge. Much of this can be avoided if assignments are structured so that students must rely on each other, if the instructor has the chance to actually watch groups in action, and if there are non-threatening opportunities for student teams to meet with the instructor.

There is no doubt that teaching teamwork can be labor intensive, but once policies are found that work and systems are put in place, it can be enormously advantageous. It provides students with a taste of how they will have to operate in the world of work; it begins to hone skills that are invaluable not only in their professional lives, but in their personal lives as well; it allows them to draw on the expertise not only of their teachers but of each other; and it gives them a sense of how they can continue to learn once they leave MIT.✠

[Lori Breslow can be reached at lrb@mit.edu]

Annals of Reengineering

SAP Rollout Continues

Janet Snover

Following a detailed planning effort, the rollout of SAP to departments, labs, and centers (DLCs) has begun, and financial staff in your areas are being trained for more extensive use of the software.

Though SAP has been MIT's "system of record" since September 1996, the software has been used primarily by central offices such as the Controller's Accounting Office (CAO), Purchasing, and the Office of Sponsored Programs. Staff in DLCs were trained (beginning last August) to use SAP for looking up accounts payable and purchasing information, displaying sponsored billing data, and for generic reports such as an account summary and detailed transaction report. Now, staff in DLCs are becoming more active SAP users.

Major goals for the rollout include the following: give DLCs a tool for directly controlling the authorizations of who can do what in SAP; allow full use of MIT's new financial architecture; simplify procurement by DLCs and reduce central "back office" expenses; speed up fiscal year-end closing and increase the visibility of financial data; and reduce central operational costs and multiple administrative systems.

Milestones

The first milestone in the rollout is called Status and Departmental Education. The Management Reporting Project, which is leading the implementation effort, held information sessions in late March to give administrative officers background on the timing and content of the rollout. These sessions were followed in April by a series of "Concept Workshops" on the following topics: Planning Your Department's SAP Implementation, Financial Architecture, Purchasing with SAP, and MIT Reporting Strategy. These workshops provided the information that administrative and financial officers needed to help plan how they will use SAP and who are the appropriate people to train.

The second milestone, Extended Reporting, begins in mid-May and is expected to run through mid-July. It will provide tools that assist in departmental budgeting, the Executive Information System (for summary financial data), internal provider billing, manual reservations (for setting aside money that will be spent later), SAP printing and reporting, and the MIT Help Desk. Phased Offerings is the name of the third milestone, which runs from mid-April through August. Functions here include the MIT credit card, the Data Warehouse, the electronic catalog (ECAT), electronic journal vouchers (internal MIT accounting entries), and purchasing from NECX for computers. Departments will decide when they want to begin using these offerings.

The largest and most complex milestone is number four, called Procurement. Training and "go live" are scheduled to run from September 1 through December 31. This milestone will include change orders to purchase orders, ECAT II, funds availability checking, internal provider requisitioning, the labor distribution system, and contracts (blanket orders) and requisitions in SAP.

The kinds of questions that must be answered in DLCs to prepare for procurement include the following:

• Who can create, change, and display requisitions?

• Who can approve a requisition (with various dollar totals) and release it to Purchasing?

• Which requisition approval rules are best suited for your department?

• How should all of your "cost objects" (accounts) be grouped for purchasing functions?

• On which cost object groups can each user perform purchasing functions?

Milestone five, from mid-September to the end of 1998, covers many technical and infrastructure issues as well as Phase III planning. Conversion of legacy systems will be a major part of this milestone.

Pilots

The Sloan School of Management and the Administrative Services Organization (ASO) in the School of Engineering have served as pilot sites for SAP. Lessons learned from the first pilot at Sloan resulted in a smoother experience for the ASO. "It's been a really positive process for us, and I think you'll be pleased with SAP," Elizabeth Cooper, director of the ASO, told administrative officers at the first information session in March. She reported ASO was having minimal problems, and that she and her staff were rapidly gaining experience in using the software.

Support Services

Many MIT staff members and offices are involved in supporting the rollout as it goes forward. Staff in the new School Coordinator positions provide a liaison among Management Reporting, the DLCs, the Accounting Office, Audit Division, and Information Systems. Another important part of the School Coordinators' role is to consult with administrative and

SAP Rollout Continues

Snover, from preceding page

financial officers to help them analyze their needs. The Coordinators report jointly to Katherine Cochrane, director of the Management Reporting Project, and to Doreen Morris, assistant provost for administration.

Management Reporting's training and documentation team continues to play a key role in the implementation of SAP. They have already trained more than 800 staff members in SAP basic skills and reporting, and have issued documentation in print and on the Web. As with the pilots, user comments about the first phase of training are helping to improve the next set of classes that are being developed. After users have had training in the new functions, they will be able to practice their skills in what's called the "sandbox" environment before they start doing live work in SAP.

The Help Desk will provide assistance to people with basic

questions and replicable problems using SAP. In addition, Information Systems will provide a new business liaison function later in the spring for the deeper technical needs and business issues that arise.

Faculty with questions about the SAP implementation may contact Robert Murray, communications manager for the Project, at 258-7318, e-mail <rmurray@mit.edu>.

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Fiscal Year Closing

Another topic related to finances, which will affect some staff members in your areas, involves changes in the closing procedures for fiscal year 1998. A government-required A-133 audit means that MIT needs to complete the closing of its financial books a month sooner than in prior years. In addition, the Audit Committee of the MIT Corporation requested that the closing be finished earlier so that

senior management would have access to the information more quickly.

According to Controller James Morgan, CAO will work closely with departments throughout the process. There will be an early cutoff – June 26 this year – for internal billing units. Departmental staff are being trained to do journal vouchers electronically in SAP, which will save time and effort. All academic units will be able to carry forward unexpended general funds automatically. (Academic units are areas that report to the five Schools, the Vice President for Research, the Provost and Associate Provosts, the Dean of Students and Undergraduate Education, and the Libraries.)

Faculty with questions about the closing may contact Controller James Morgan at x3-2749, <jlmorgan@mit.edu>.✣

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Reengineered Mailing Lists/Mail Services Cause *Newsletter* Delivery Problems

Newsletter Staff

For some of you, this will be the first issue of the *Faculty Newsletter* you received through the Institute mail this year. For all of you, this issue will likely have been delayed in delivery by some arbitrary time.

A Reengineered Institute mailing list in combination with a Reengineered (and thus overworked and understaffed) Mail Services has resulted in an often delayed and for all-too-many of you non-delivered *Faculty Newsletter*. The staff of the *Newsletter* sincerely apologizes to all who have been adversely affected, and particularly encourage those of you missing back issues to contact us for their replacement.

We *have* been trying to resolve these problems. Partially at the encouragement of the *Newsletter* a recent on-line mailing labels ordering feature has been added to the MIT Website. This has speeded up the

often interminable delay (and necessary multiplicity of required requisitions) prior to the printing of Institute mailing labels. In addition, close work with personnel involved in the generating of the lists has (we hope) returned many of our "lost" readers to the fold.

Working out the problem of delayed delivery of the *Newsletter* appears to be a bit more complicated. A hierarchy of labeling and mailing priorities exists at Mail Services to accommodate mailing priorities (*Tech Talk*, messages from administrative officers, etc.). This has resulted in as much as a week's delay between delivery of the *Newsletter* to the Institute and its appearance in your Distributed Mail Center(!). Due to cost cutting in the Reengineering of Mail Services there are now simply no personnel available to expedite the process. (It should be noted that the Mail Services people

with whom we've worked over the years continue to do an outstanding job and appear restricted by regulations and lack of sufficient work force.)

Mail Services has probably received the most general criticism of all aspects of Reengineering (SAP, notwithstanding). A target visible to all, its elimination of personal service in conjunction with its "return-from-the-dead" mail delivery (where people who have been out of your office, the Institute, or the planet for years suddenly begin receiving mail) has left it somewhat vulnerable. Perhaps a reevaluation is in order.

So again, to those who have failed to receive past issues of the *Newsletter* we apologize, and say "welcome back." And for those who would like to read the *Newsletter* in a more timely fashion, we point you to our Website, <http://web.mit.edu/fnl>.✣

M.I.T. Numbers

Factors that Impede Faculty Use of Technology in Teaching at MIT
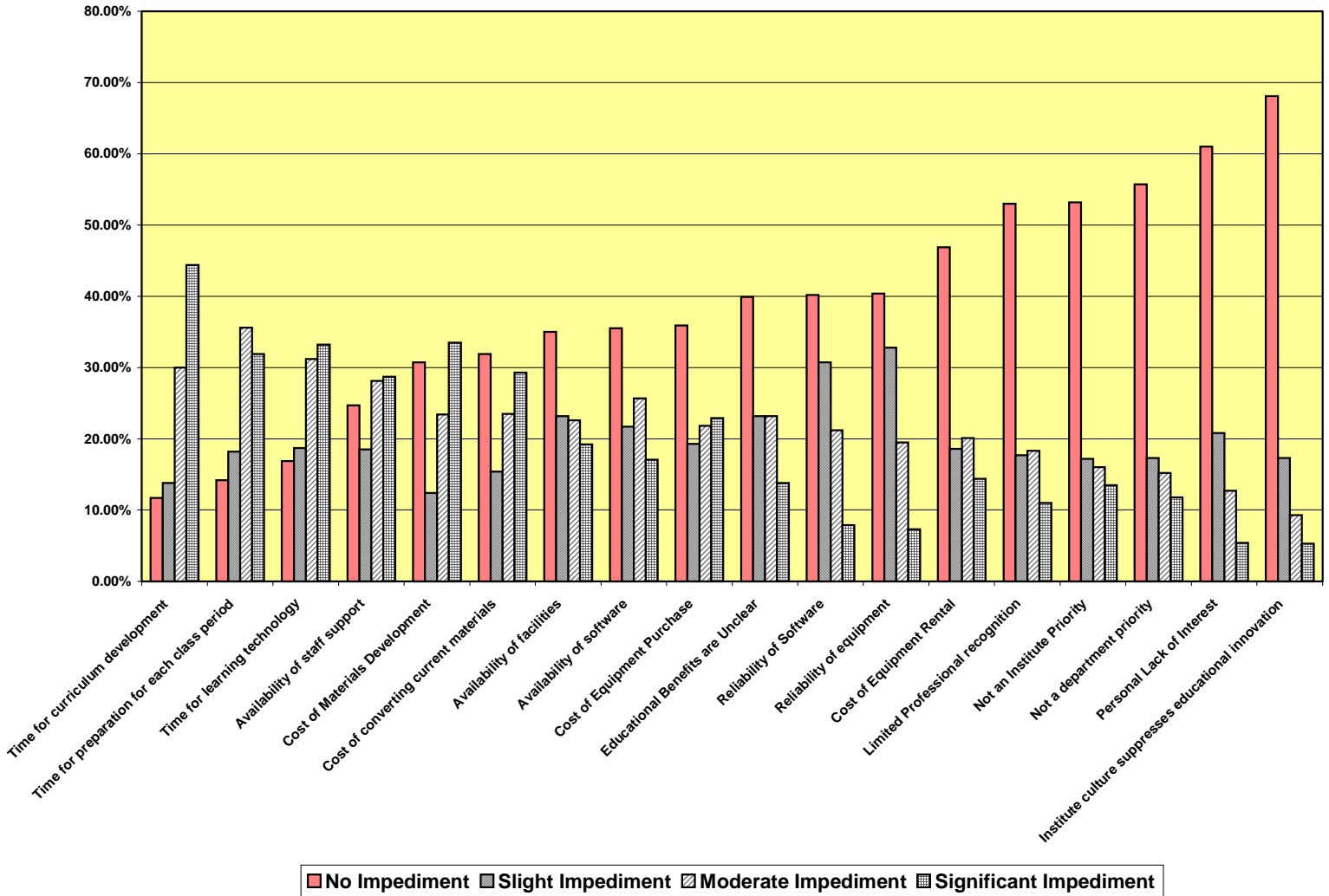
Source: *Faculty Survey by Task Force on Student Life and Learning*