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Some Thoughts about Teaching and Technology
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A recent article about "technology holdouts" in the *Chronicle of Higher Education* (Jeffrey R. Young, July 24, 2010) prompted me to think about my own relationship with technology in my teaching, and my experiences over the past fifteen or so years. To put that time frame into perspective, it's worth noting a few landmarks from that era: first, the transition from a goverment-controlled network (ARPAnet, later NSFnet) to a public Internet was completed in 1995. Netscape Corporation, whose Web browser was the first to be used by early "Webizens", had their first public stock issue in 1995. Most of the technology currently in use (both hardware and software) did not exist fifteen years ago. And, perhaps most interesting in the context of teaching, most current post-secondary students had not yet started school in 1995, so all of these landmarks (and many other technology changes since) have functionally existed for their whole lives. This latter point has been repeatedly made by the annual "mindset list" published by Beloit College (http://www.beloit.edu/mindset/), which note landmarks for each cohort of incoming students. However, my focus in this essay is not how technology has changed the experiences of students, but rather with how technological changes have (or have not) changed teaching.

It should be obvious that technology, and it's role in teaching, has been evolving throughout recorded history, from clay tablets, through pen and paper, printed books, ballpoint pens, and so on. Technological change is not new; if there is any significant difference in the past fifteen years, it is simply the rate of change, not the existence of change. At the same time, rate does matter, especially when the changes come so quickly within a human lifespan (as the mindset list emphasizes). While the learning capacities of the human brain have not changed in the past fifteen years, this does not mean that teaching can or should remain static--and trying to sort out what to change, and what *not* to, has been an on-going journey for me. To understand this journey (which I know has been shared by many others involved in teaching), it may help to know something of my personal background.

My teaching career actually extends back forty years, to when I was a graduate student in psychology. So, in terms of technological change, my experiences include using Fortran on main-frame computers, "mini-computers" from PDP that were the size of a phonebooth, the first hand-held calculators (from HP), DOS-based PC's, and more. While all of these served as useful tools, I have to acknowledge that none have had an *enduring* impact on the way I teach (or learn). Though I have never been an academic Luddite, neither have I ever seen new technologies as a panacea for the challenges I face as a teacher. In this sense, I suspect I am like the great majority of teachers, who occupy a middle ground between the extremes of rejecting or embracing all new technology.

Still, while most teachers may fall somewhere in the middle of the continuum, it is likely that the distribution is skewed toward rejecting (or at least not embracing) new technology. This was underscored for me some years ago, when I came across the observation that overhead projectors were adopted in bowling alleys at least a decade before they appeared in most classrooms! I suspect that the key reason for this phenomenon of slow adoption (which has also played out with other, more recent technologies) is that most teachers are fundamentally conservative--not politically or even socially, but in the sense of wanting to preserve what is good in what currently exists. This was best expressed for me by Steve Gilbert of the AAHE, who said that the key questions in considering the use of technology in education are, "What to you hope to gain? And what do you not want to lose?" I would argue that these two questions should be at the forefront in considering any adoption of new technology in teaching, and also in evaluating its impact.

These questions may have different answers depending on one's perspective, but asking them is almost always likely to be useful. For the remainder of this essay, I will highlight a few examples drawn from my own experiences, in the hope that they may help others who struggle to sort out the role of technology in their own teaching.

Exploring how to introduce technology

First, I should note that I chose the timeframe of the past fifteen years both because it is relevant to the perspective of current students (as noted above), but also because it coincides with the period of my own most significant experiences in this domain. In the early 1990's, I became an early web-user, exploring Unix-based hypertext. (The "H" in HTTP, the protocol developed by Tim Berners-Lee which laid the foundation for the World Wide Web.) When Mosaic (a Windows-based Web browser that preceded Netscape), appeared, I became intrigued by the potential to use hypertext to make learning materials which would allow students to read material in a personally-chosen sequence. Since I was aware Ryerson was already funding a project using custom software for a similar purpose, I decided to apply my skills as a cognitive psychologist to compare this custom system and hypertext. The results of a pilot project clearly favored hypertext, and with the advent of Netscape, the university abandoned its custom software project in favor of Web-based development of learning materials.

This initial project underlined for me the importance of *evaluating* technology used in teaching, not just *adopting* it--and my background in cognitive psychology assisted me in this task. The project also led me to greater involvement in the issues of technology adoption which were beginning to roil the waters at my university (Ryerson), as they were at most post-secondary institutions. Shortly, I became chair of the campus group dealing with enhancing teaching and learning (called GREET at that time, and now the Learning and Teaching Office).

In that role, I attended a national conference of the American Association of Higher Education, whose theme that year was "teaching and technology". It became obvious that new technologies were sprouting everywhere, but that most schools had no clear plan for adoption, and even less clarity about evaluating the impact of changes. Steve Gilbert of the AAHE talked about a model for guiding adoption called "teaching, learning and techology roundtables". These TLT roundtables were cross-campus groups focussed on leading technological change, guided by the two key questions I noted above. Two colleagues and I went back to Ryerson, arguing for the need for such a group; to their credit, the president and provost saw the value, and an ad-hoc committee was created to deal with the implementation of new technology in the classroom. This group, the "presentation technology implementation committee" (PTIC) involved faculty, IT staff, campus planning, timetabling, and other areas; over the next five years, I served as its chair, while Ryerson went from having essentially no digital capabilities in classrooms to having projectors in roughly half of all classrooms, and sophisticated systems with computers, video, audio, and document cameras in a sub-set of classrooms.

From the beginning, the concern of the PTIC was not simply to introduce technology, but to do so in a way that kept educational goals at the forefront, and emphasized collegial co-operation to ensure desired outcomes. Early on, the committee examined what was happening at other universities which were early adopters; not surprisingly, many schools reported growing pains, involving everything from teacher training to timetabling technology-equipped classrooms. The point that quickly became clear was that technology which was opaque to users (teachers) would be ineffective and even disruptive to the teaching process, not beneficial. Consequently, it was decided that systems needed to be designed with a user-friendly touch-screen, with an interface that was consistent regardless of the specific components in a particular room. (Anyone who has struggled with remote controls, whose design varies by brand and sometimes even model, should understand why a consistent, user-friendly interface was seen as a priority, despite significant up-front costs.) Once the first few systems were installed, evaluation was conducted with both teachers and students about the benefits and limitations; this feedback was crucial in enabling incremental improvements in the design of the classroom systems. (It should be noted that other issues also needed to be addressed: Choosing which rooms to target for installations, especially in the early days of limited resources, required input from faculty, but also from timetabling about scheduling constraints and which rooms had high usage rates, and from campus planning about physical evironments and timelines for construction, etc.)

Not surprisingly, early adopters of these classrooms tended to be curious about new technologies, and commited to continually enhancing their teaching; consequently, they were generally both quick to adapt and creative in finding new uses. As time went on, and the use of classroom technology spread to more mainstream teachers, training about both the technology and its effective use became major concerns both logistically and pedagogically. The PTIC no longer exists at Ryerson, but these issues are still on-going challenges, which are now handled by Media Services and the Learning and Teaching Office. Overall, my involvement with the process in the early years underlined a few key points:

1. technology adoption must be driven by teaching goals, not vice-versa (recall Steve Gilbert's two questions).
2. effective adoption requires the involvement of all affected groups, not top-down decision-making.
3. evaluation of outcomes needs to be integral to adoption, and ideally needs to be considered from the outset.

Getting personal with technology

The previous section talks about the introduction of technology from an institutional perspective, albeit guided by a pedagogical focus. For most teachers, however, the issues are much more personal and individual: "what should I be doing?" Let me state at the outset that I don't believe there is a single answer to this question, whether one is talking about technology or even general teaching techniques. Several times over the years, I've reviewed the literature on identifying teaching excellence, and it is clear that there is no single model of excellent teaching. Similarly, there is no one set of technologies, or way of using them, that is ideal. At the same time, there are some options which may be generally useful, and some which are generally best avoided. Let me offer a few observations, drawn both from the literature and from my own experiences.

The promise and perils of Powerpoint: The use of presentation software has become so ubiquitous that a brand (Microsoft Powerpoint) now serves as synonym for a category, much like Band-Aid or Kleenex. Unfortunately, the transition from rare to ubiquitous has not been accompanied by a parallel increase in understanding of how to use such software effectively. When I first started using "powerpoint", I was fortunate to be able to draw on my knowledge of cognitive psychology in deciding how to design presentations. One of the most common errors is putting too much information on a slide: in one extreme case, I attended a presentation being delivered to an audience of over 1000 academics; the presenter (a PhD in education no less!) presented several slides covered with columns of data, equivalent in size to newsprint. What was the intention? Reading it was impossible--and even if I could, it would have meant ignoring what the presenter was saying for several minutes. In my experience, an effective slide has three or four bullet points, each consisting of a phrase; if details are needed in visual form, they are better conveyed by a chart or graphic, or distributed as a handout/web posting. Planning the amount of information on a slide is important, but it is not the only variable that matters. Space does not permit discussing all aspects here, but I believe that a badly done presentation is worse than none at all--indeed, it can be dangerously uninformative. For examples, see the work of Edward Tufte, a graphic designer who has extensively documented cases of Powerpoint problems, including their role in the decision-making which led to the Columbia space shuttle disaster in 2003. (http://www.edwardtufte.com/)

Keeping students' attention: Organizing presentations with limited information is important in terms of cognitive loading, but also helpful in keeping students focussed on what I am saying, not on reading slides. (I often further emphasize this by presenting bullet points sequentially, rather than all at once.) In recent years, with the advent of web portal/course management systems like Blackboard, it has become easy to post slides in advance of lectures. Interestingly, in my experience, doing so has not detracted from attendance--because the sparse content makes it clear that the slides are an outline, not a substitute for being in class. Feedback from course surveys confirms that those students who download in advance (the majority) find the slides provide a ready-made outline for their notes; those who miss a class have a sense of what they've missed--but realize that details must be sought from classmates.

In terms of attention and classroom dynamics, presentation software has freed instructors from chalk dust and the time required to write on a board or overhead, but has created other challenges. First, pacing can easily suffer, since it is easier to race through material, leaving learners with no time to assimilate or even

write. Second, if the teacher is unwilling to break the flow of the slides, the class becomes more static, with little room for questions, interaction, or serendipitous digressions. Pausing to ask/answer a question, write (on a board, overhead, or document camera), or even just move away from the computer, can be crucial to preserving life in the class. A third point concerns lighting levels: semi-darkness not only makes it hard for students to write, but makes interaction between teacher and students more difficult. Modern projectors should allow usage in near-normal lighting; if this isn't the case in a particular room, a projector may not be worth using.

Technology and social communication: Without a doubt, technological change has been dramatic in terms of social communication. In the past fifteen years, asynchronous communication has become pervasive, from voicemail and e-mail to social networks like Facebook. With it, most teachers have found a decline in face-to-face interactions with students outside class, but a significant increase in asynchronous communication. Whether this has reduced or increased workloads is debatable; that it changes interactions is not. In my own experience, e-mail can be enabling for some students--shyness, disabilities, and time constraints are less of a barrier when communication does not require coming to office hours. At the same time, some students abuse such communication tools--ironically, because of the same attributes. Like nearly all faculty, I've encountered students who are over-familiar, make ill-considered requests, etc. To cope with these concerns, while still enabling the students who benefit from such communication, I've adopted a few techniques. The most fundamental is norm-setting. At the beginning of a course I would note various "etiquette" items in class, including arriving on time, turning off cell phones, and appropriate ways of contacting me; the course outline also would indicate options and expectations for communicating with me. (For example, the course website would have a discussion list with a section for general questions; if students e-mailed on such issues, my response simply directed them to the discussion list. Few students would make such queries twice.) In the end, such forms of asynchronous communication are still evolving, and educational culture is still evolving to deal with them. We can't really turn back the clock on such tools, but we can be more proactive in finding ways to balance their advantages and disadvantages.

The other aspect of technological changes in social communication concerns the shift to an always-on, always-connected culture. The advent of cell phones and wireless internet connections means that in any class, students have potential access to text messages, Web surfing (whether on laptop or cellphone), and postings on Facebook, Twitter, etc. There is no doubt that such communication can distract students' attention and can seriously impair the engagement and interaction which are an important part of both teaching and learning. (Even in a "lecture", students need to be engaged). Setting a norm of "cellphones off" is important at the very beginning; on occasion, I've even (tactfully) reminded individual students early in the course. Such an approach has meant cellphone use in class becomes largely a non-problem, but dealing with laptops is not quite so simple--to the extent that some faculty adopt "no laptops" rules for their classes. When laptops are used for note-taking or other course-related matters, having a "no laptops" rule is impractical; even where it seems technically possible, my own view is one should not do so. The most basic reason is that it implies a "presumed guilty" attitude about misuse, and this seriously undermines the classroom atmosphere, which for me has always been based on building mutual respect. Beyond that, while some students may surf the web or check Facebook, the fact that they are unengaged is not simply the fault of technology; after all, there have always been students who daydream, doodle (a simpler technology, but still technology!), etc. Long before the advent of laptops, I decided that attendance would never be mandatory in my classes, or graded. As I would tell my students, "you won't get a grade for simply occupying a seat--and if you really have something you consider more important to do than being in this class, then maybe you should do it." For me, this is about pedagogy, not technology: I believe students need to be engaged, and making them captives does not foster this. As a result of my attendance policy, students who attend class (with laptop or not) have made a decision to be there, and are very likely to focus on the class material, not distractions like the Web. (On occasion, I've also had students use the Web beneficially in class, by finding material related to the class topic, and sharing it with me and the other students.) Interestingly, comparing notes with colleagues indicates my attendance policy has not led to poorer attendance than other faculty, and course surveys indicate above-average satisfaction with my classes (though clearly attendance policies are not the only factor involved in these outcomes).

Conclusions

As I've tried to indicate, technological change has had a significant impact on the teaching process in recent

years, and the pace of change is unlikely to decrease in the forseeable future. While a faculty member in the early twentieth century could likely have gone through their entire career without being forced to face any such changes, no teacher today can be complacent. As noted earlier, my own approach is to seek the middle ground between Panglossian embrace of "the latest thing" and Luddite rejection of all change. For me, technology--*all* technology--is simply a tool, not a goal. Teaching has always meant the pursuit of ways to share my knowledge, and to guide students in their own quest to learn. I feel supported in this attitude when I think about the real meaning of "education". The word itself comes from Latin, *educere*, which means "to draw forth"--the process is *not*, as some would have it, about cramming in information or even imparting pearls of wisdom. There are many ways to educate, and any commited teacher will always seek better ways to fulfill their role. In terms of technology, my view of education and teaching takes me back to Steve Gilbert's questions: "What to you hope to gain? And what do you not want to lose?" If you can find your own answers to these questions, I don't think you need ever fear the challenges of new technology in your teaching.

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