Learning Spaces and Shared Decision Making

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Introduction

This paper investigates very different ways of using digital technologies in college classrooms -- each based on common concerns of a certain group of disciplines, mathematics in the first instance and English and the humanities in the second. The authors have noted in previous papers that differences in the discipline do account for widely varying levels of utilization (or non-utilization) of technology in the college classroom. First there is a review of the status of typical classrooms or learning spaces in today's college or university; then the authors look at how two disciplines use (or do not use) available technology today. Finally, they speculate about mechanisms that might improve the useful design and construction of learning spaces that impact their own disciplines.

Today's Classroom

"Learning spaces" as an object of design and study have received much attention in the higher education community in the past 5 years. Indeed, Diane Oblinger put together a collection of interesting and innovative studies on the need for rethinking the design of the traditional classroom in an Educause/ELI publication of the same name [Oblinger, Learning Spaces]

The traditional lecture room-the instructor in front, students in rows facing forward-- is still the most common physical classroom model on college campuses today. The furnishings are usually more flexible and, except for very large lecture halls, today's classrooms rarely have furnishings fixed to the floor. Nevertheless, board and lecture space is typically at the front, placing the focus on the front of the room (and on the instructor as the source of primary content). Essentially unchanged for centuries, that model is nevertheless in rapid flux: most campuses now feature easy access to computer, Internet and electronic media tools in every (or virtually every) classroom. Indeed, in some contexts it is not unusual to have several display screens.

As Malcolm Brown of Dartmouth [Brown in Oblinger, Learning Spaces, Chapter 12] put it: "As recently as a decade ago, classrooms were the primary locus for learning in higher education. …Since then, a great deal has changed. The World Wide Web has emerged as the primary way

most people use the Internet. … Laptop prices have declined … to the point that their use exceeds that of desktops for most students. … These developments impact the locus of learning in higher education. The notion of the classroom has both expanded and evolved; virtual space has taken its place alongside physical space."

What one would hope to see, then, as the technology and our ability to use the technology evolve, is a shift from technologically-enabled traditional classrooms to the learning space, in which the technology becomes part of the learning space itself.

This is happening in some limited contexts. For example, on our own campus, the recent construction of a new School of Education Leadership building involved dedicated faculty input from the planning stages onward, and the resulting learning spaces incorporate collaborative learning designs as well as the unobtrusive use of technology. The Wallenberg project at Stanford University provides a flexible and experimental learning environment to assess the impact of new technologies in teaching, primarily through the use of (1) enhanced interactive digital media in the room itself and (2) adjacent breakout areas, also equipped with interactive digital media. (Wallenberg, Classroom Details)

Nevertheless, at all too many universities new ways of thinking about learning spaces lead to, at best, modest changes in classroom design. There are several reasons for this. One is lack of either faculty participation or faculty interest. In the case of a new building, faculty interest is high, but in the case of limited renovation (far more common on college campuses) faculty interest and involvement drops considerably. Secondly, while facility project managers and instructional technologists involved in the design of new classrooms or learning spaces may encourage and desperately seek faculty input, their own interest in the facility tends toward the technology rather than the pedagogy. The result can often be a traditional classroom retrofitted with grand (or not) technology. Thirdly, budget issues often constrain those design goals that might most significantly impact a changed 'learning environment.' Finally, most classrooms are shared facilities. This means that the design reflects the most commonly utilized technology – in effect, the least common denominator. While this works well in some instances, it does not foster much in the way of innovation. When demolition and structural costs remain fixed, what most often suffers is innovative furnishings and, to some limited extent, technology innovation.

It is, in fact, true that specialized teaching environments exist – labs for the scientists, performance rooms for drama, and even some specialized general purpose learning spaces. But, sadly, this is not true for most disciplines in the humanities.(In fact, the philosophy of specialized learning spaces for the humanities has yet to be developed—what do the humanities do, why do they do them, and how can digital technologies help? (Questions without, thus far, answers.) While other disciplines have made the case for alternative designs decades (at least) ago, the impact of these new digital technologies has tended to differ markedly depending on the discipline.

All that being said, what passes for the standard classroom today is usually – though by no means always – a traditional forward-facing classroom with relatively user-friendly technology and lightweight, flexible student desks. This latter improvement accommodates, but does not necessarily encourage, a flexible, and easily changeable environment. Any change in curriculum and pedagogy must take this fact into account even as changes in classroom design evolve.

A Mathematics Class in this Environment.

Teaching and learning research supports the role of technology in the mathematics and the science classroom. The National Research Council document "Evaluating and Improving Undergraduate Teaching in Science, Technology, Engineering, and Mathematics" emphasizes that teaching faculty cannot merely be experts in a discipline; they also must possess a wide range of experiences and skills with appropriate pedagogies and technologies used in that discipline. "…Instructional changes made possible through information technology are profound and have already imbued research communities in the natural science, mathematics and engineering. ...As with other areas of pedagogy, [science and mathematics] faculty will have to learn appropriate and effective uses of hardware and software that are coupled with new ways of learning and teaching." (Fox, Hackerman, 2003, 28-29)

The crucial point in learning mathematics is not primarily the procedural or instrumental aspects of the discipline. True learning involves the understanding of the conceptual framework in which the procedural aspects of the discipline and related concepts interact, and can thence be used for creative application to other mathematical problems. Put another way, procedural learning complements and outlines conceptual learning (Goodchild & English, 2002, 121). Learning concepts involves more than learning methods. Expert knowledge and function includes the organization and understanding of concepts that underlie these procedural methods (Bransford, Brown, Cocking, 1999, 19ff). The question, of course, is: "To what extent do new interactive, digital learning tools facilitate conceptual learning in the mathematics classroom?"

Document cameras, data projection displays and perhaps the use of a distributed learning system such as Blackboard or WebCT are all common features of a college mathematics classroom today. Calculators are an essential tool in many mathematics courses and specifically in algebra classrooms both at the secondary and college level. Indeed, as far back as the mid 1980s, researchers (Hembree, Dessart, 1986, 83-89) have emphasized the impact of hand held calculators in pre-college mathematics education. Graphing calculators have further accelerated the interest of mathematics educators (Murdock et al, 1998). But, other than calculators, tools that are aimed at the discipline of mathematics or encourage collaborative and group learning are less frequently encountered in lower division mathematics classes.

There are some collaborative teaching tools gaining a foothold in undergraduate mathematics courses. Audience Response systems (aka 'clickers') are gaining in popularity with many faculty in science and mathematics because they may be used to easily test and gauge the level of understanding for a particular concept being taught. These systems include inexpensive polling devices and a one-time expense for a wireless reception device that can be packaged with a text and then used by the instructor to poll and instantly categorize responses using either the web or other delivery application (e.g., PowerPoint).

But what of interactive technologies specifically aimed at the teaching of mathematics? These are the tools at the heart of change in teaching mathematics. Mathematics involves hands-on activity with a complex symbol set. There are computational engines such as Mathematica or Maple that allow for sophisticated manipulation of complex symbolic math, but these are rarely seen in secondary level or lower division college algebra or survey of calculus classes. There are a few rather interesting exceptions. For example, Abby Brown, of Torrey Pines High School, used Mathematica with her calculus as well as algebra classes and has even published students' work using the tool (Brown, 2005). But using such computationally powerful teaching tools is the ex-

ception rather than the rule even in the upper division college classroom. The Geometer's sketchpad is perhaps a more appropriate tool for experimentation at the lower division college mathematics level.

Currently, lower division mathematics courses are increasingly using publisher-based online problem tools that are a vast improvement over the drill and practice computer-based instruction programs of the late 1980s and early 1990s. And, like any other discipline, there is a wealth of auxiliary educational video and media materials that might be used in exploring mathematical concepts.

The classroom in which these tools are used is, in practice, effective enough. The design of the classroom is still that of a lecture classroom and collaborative work requires reconfiguration – not a major problem, but still time consuming. So, while there are liberally spaced opportunities to have students work together, they do not and, indeed, would not in any case, take up a majority of class time.

Also, while the class size is not large, nevertheless, the class usually has 30 or more students of varying abilities and there has to be ample opportunity for individual exercises to build computational and problem solving skills. Even with a grader, assessment of students' work is time consuming – especially if the instructor takes seriously his role of asking questions and also pointing out alternative approaches. Thus, in the author's own college algebra courses, the instructor uses an online teaching tool that supplements written and text book exercises. Online homework assignments use MyMathLab – a publisher based instructional tool (Pearson Publishing). This is an interactive problem solving tool that uses a moderately rich tool set which instructors can use to assign both assessments and assignments that students can do on their own time from any windows-based workstation. The strong point of this approach is that students can not only learn at their own pace, they also receive help in working through the problems step by step. MyMathLab does not just present problems. If the student has difficulty with any stage of understanding the topic under review, it guides the student through similar examples and offers helpful review. Based on student evaluations over the past 3 years, the students find the tool easy to use and prefer it to written assignments which the author still requires. This result mirrors the experience of others using the tool (Trigsted, 2006).

Also, the author provides a limited number of online flash modules that explain particularly difficult concepts and provide some limited examples of both problem solving and graphical analysis skills. These are not intended to substitute for lecture, but they do provide an 'any time' exercise

So, while there are a substantial number of illustrative content modules that secondary and college mathematics faculty can draw upon in illustrating mathematical concepts, these tools differ in both in quality and ease of use. Wolfram Research Incorporated (Wolfram, 2007) provides a Mathematica Player for use in teaching and education and provides a website where interested instructors can search for illustrative modules on particular topics. However, most of the examples are aimed at majors' level calculus or abstract algebra as opposed to lower division algebra topics. One particularly apt example involves sketching a rational function where the user manipulates both the roots and asymptotes, yielding real-time graphical proof rational functions are affected by roots and asymptotes, occurring as changes of sign for continuous functions.

The Humanities in this Context

Nothing like these tools exist for the humanities disciplines; nor, we would argue, could they.

This is not to say that the humanities have not been affected by the digital revolution; they have been, in profound ways. Simple word processing was (and is) in itself a revolution, compared to the typewriter; email has been similarly revolutionary, if we remember (a) that the only alternatives had been snail mail and the telephone, and (b) that writing is at the heart of what the humanities disciplines try to accomplish. More important still has been the web, primarily because it has offered (and soon will offer more) access to content that previously would have been difficult or impossible to obtain. Cultural artifacts of all kinds, but especially the most ephemeral—pamphlets, posters, manifestos, hastily scribbled notes, not to mention accurate digital representations of ancient and/or fragmentary texts, have revolutionized scholarly work in the humanities, where for generations simple access to texts had been an enormous and time-consuming problem. Given that the mission of the humanities (CHAT, About) is to find, explore, and articulate the meaning both of cultural artifacts and the methods we use to look at them, the impact of this revolution can hardly be understated.

And yet: word-processing and email have impacted everyone, not just students of the humanities; and while access to content is now light-years ahead of where it had been, "access to content" is essentially the function of a library. We have, that is, a far better library than we have had before. While this is an enormous gain, it is not in itself revolutionary, if we ask how any of this could or should impact *teaching in the humanities disciplines. The issue, actually, is complex. What and how we teach is in part a function of what we understand the purposes of the humanities to be, and here consensus is difficult to find—largely because, in a post-theory age, the "author" as the sole source of meaning in the text has been co-opted by culture, by gender, sexual orientation or indeed by language itself; such that words like "purpose" or "goal" in the humanities disciplines have become increasingly more contingent, endlessly receding before us like a desert mirage. In circumstances such as this, what, exactly, would digital technologies help us do? (We note in passing that in mathematics, as in many other disciplines, "purpose" is by comparison unambiguous.)

How Might We Do this Better?

We are struck by the fact that, while faculty in some disciplines are, by virtue of their own interests and the needs of their disciplines, attuned to and interested in the use of digital technologies in the classroom, others are not. We are also struck by the (apparent) fact that instructors in the humanities disciplines have no particular use for the technologies Pope describes….nor could they, given the state of (the culture of) their own disciplines. Humanities faculty don't know what to do, beyond what is already available, with technology; nor *can* they know, given the state of their disciplines

The problem is compounded by IT departments that, by virtue of their mission, must serve many departments (including administrative departments). Unless a new building is planned, or a massive reconstruction, department-based faculty tend to be less involved unless they will be specific users of that structure. We think, then, that the central problem on university campuses regarding IT issues reduces to

(a) A tendency on the part of IT staff to plan for the entire institution, when in fact disciplinary needs vary widely; they don't know what they don't know.

(b) A tendency on the part of certain (humanities) departments not to address (for good reasons) their own core needs and practices; they don't know what they don't know.

What to do? Dialog is the best answer (it usually is), but dialog conducted on a different basis than it tends to be now. Instead of working primarily with those faculty who are already interested, IT staff need to actively, personally, address departments regarding their needs and interests. Often, however, such sessions reduce to which faculty needs which service or piece of equipment, or which isn't working. The question needs to be framed differently: what is it that your discipline (your commitment) requires you to do? (Not, that is, what the latest technology will let you do. That may be relevant, but it also may not be.) What kinds of experiences do you want your students to have, and how do you want them mediated? Beyond the experiences your students are having now, what kinds of experiences would you like them to have (forgetting, for the moment, whether they are feasible or not). The discussion, that is, is not about the technology. It is about them.

The answers may be—almost certainly will be—various. And yet this is the kind of discussion we need to have, if IT departments really do want to serve all their customers equally. Asking questions like these, moreover, will bring to the fore questions much debated in the current cultural climate within the humanities; the debate will not end, but in looking at these questions collectively each department will—not achieve consensus; but make some progress in thinking about technology *for* them, instead of technology thrust *at* them. This in itself would be an improvement over the current situation.

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