Making instructional technology count

John O. Mitterer
Associate Professor
Department of Psychology
Brock University
St. Catharines, Ontario
L2S 3A1, Canada
mitterer@brocku.ca

Abstract

We all want to make the university a place where the sharing of knowledge occupies its rightful central role. Of the many different dimensions of this issue which have concerned me over the years, the one which has most occupied me has been a sustained exploration of the uses of the new digital instructional technologies (IT), both individually and institutionally. Accordingly, it is my goal in this paper to share with you the conceptual framework I use to situate my own technology use in a broader context. I argue that we must begin with a clear understanding of what we want to teach (content knowledge) which we express through a clear understanding of how we want to teach it (process knowledge – the processes of teaching and learning). Only once we have created some domain-specific effective instruction by expressing content knowledge via process knowledge can we helpfully consider how to use tools, including IT, to realize a concrete set of materials for our students to encounter and learn from.

Introduction

We will not clearly understand the use of information technology (IT) in teaching any time soon. It is difficult to be sure that one's use of IT is optimal, helpful, or merely a novelty and today's confidence may evaporate tomorrow. This is because instructional design using IT continues to evolve along a complex trajectory for many reasons. To begin, hardware and software is still evolving quite rapidly. The phrase "ubiquitous computing" describes a future when computers will permeate all aspects of our lives. Quantitative changes, such as increases in bandwidth, CPU power, or faster search engines, translate into qualitative changes in the educational usefulness of the technology with exhilarating, if disconcerting, frequency. At the same time, cultural practices also change, albeit more slowly. However slowly, the extent to which students can profit educationally increases as access to equipment improves and digital literacy develops. University faculty also face acquiring digital literacy and assimilating the new technologies into professional practice.

The most important impediment facing faculty wishing to explore uses of IT in their teaching is a dire lack what I will call "instructional design knowledge", a problem to which the remainder of this paper is addressed. To be blunt, as a professoriate we are terribly ignorant about how to teach effectively in the first place and our ignorance is compounded when we are confronted with IT. While an emerging research base (e.g. Mayer, 1994; Wang & Newlin, 2000) offers useful insights, it is rarely consulted. Further, it is quite hard to extract immediately applicable insights from the research.

In claiming most faculty are ignorant, I do not deny content-level knowledge. We are each experts in some domain; high-energy particle physics, 14th century Persian poetry, and so on. In contrast, for most faculty teaching amounts to little more than presenting content in some cannonical order. However, other knowledge is required; knowledge of the processes of teaching and learning is critical. Perhaps the most important step in effective teaching is mapping content knowledge onto process knowledge to produce domain-specific effective instruction. Once this has been achieved, we can then consider specific tools which might be used to realize an instructional design. By "tool" I mean every possible tool from voice modulation and chalk to email and hypertext. If we have taken our content-specific instructional design and expressed it as a concrete set of materials for our students to encounter and learn from, then we have a chance of having effectively used those tools.

To summarize, in my view effective teaching flows from mapping content expertise onto knowledge of the processes of teaching and learning and only then onto tool-level knowledge. Instructional design knowledge consists of process knowledge supplemented by knowledge of how to map content knowledge onto process knowledge and process knowledge onto tool knowledge. The ignorance I spoke of earlier was of instructional design knowledge; we need more of it at every level of the university down to the individual faculty member.

Some examples of process-level knowledge

Older work focused on fostering the learning of the individual student. For example, Ausubel (1968) popularized the idea of an "advance organizer". Providing the learner prior information (a

summary, some orienting questions, an outline) makes information absorption more effective. As another example, Bloom's taxonomy of educational objectives (knowledge, comprehension, application, analysis, synthesis, evaluation) clarifies the different mental operations students go through when learning and indicates how to develop materials which appropriately engage those processes. (Bloom et al., 1956). Finally, consider the work of Gagné (1965), who offers “cognitive process instruction”, a powerful approach to mapping content knowledge onto process knowledge.

More recent work explores the cultural/social contexts within which individual learning occurs. For example, Solomon (1993) has explored the idea of "distributed cognition". On this view, we do not think just with our heads, we "distribute" our cognition into artifacts. For example, address books help us remember names and addresses. Appointment calendars, digital organizers, and other tools function similarly. Intelligence can also be distributed socially; a good example is executive who delegates details to her secretary.

One powerful idea from this contextual perspective is that of "cognitive apprenticeship". Since Lave's (1965) exploration of cognition in the context of apprenticeship, we have come to appreciate more fully how the social environment affects learning. Collins et al (1989) have applied Lave's ideas to university learning. Their idea of cognitive apprenticeship involves using features of the traditional apprenticeship environment to teach cognitive skills such as reading, writing, and mathematics. Some of these features are explicit access to the learner's intermediate products, sharing work with people of varying degrees of proficiency, and the creation of culturally meaningful products.

Moving IT forward

Despite the challenges, we must move ahead. Suchman (1987) describes differences in the planning of Europeans and the Truk Islanders. European planning involves defining a start point, a goal point, and mapping out a path between the two (and perhaps some alternatives) before setting out on the journey. This style of planning is difficult to apply to teaching with the IT. In contrast, Truks engage in situated planning; they begin a journey and make myriad decisions while under way. And so it is with us at the university. We must actively explore the use of IT in teaching and learning in just the situated way the Truks find their way from one island to another. As I see it, universities are better positioned than most social institutions to address IT within an institutional context. It is entirely natural for us to explore the application of instructional design through the use of technology.

Further, I believe that the future of the academy is at stake. We face serious pressures which, unacknowledged, may result in the eventual "death" of universities as we have know them. While this will not happen soon, I do not want it to happen at all. The biggest challenge is from new private universities. Exploiting commercialism, they can open without investing in "bricks and mortar" by granting degrees completed entirely online. Mainly untenured faculty produce reusable online curriculum, not research. Coupled with cuts to funding for public universities, this trend is worth worrying about. Imagined economies of scale dance in the heads of university administrators under increasing pressure to create and distribute online curriculum, replace tenured faculty with untenured faculty, minimize research time, and yield to the demands of the marketplace. I contend that only the "traditional" university has the tools to forge an alternative approach to IT. And it is

only thoughtful faculty at those universities who have the intellectual depth and breadth to make more of IT.

But why IT and why now?

It might be rightly counterargued that I am guilty of hyperbole. Universities have always been under threat, we have survived past threats, and we shall survive the present one as well. After all, IT is just the latest technology to be touted as presaging the death of teaching and learning as we know it (consider the printing press and educational TV). After all, already well before the birth of Christ Plato inveighed again writing as a "technology" capable of destroying true intellectation.

While it is beyond the scope of the present paper to expand the following comments, I believe that this time IS different because we are dealing with computers. I agree with MacLuhan when he suggested that "The computer is by all odds the most extraordinary of all the technological clothing ever devised by man, since it is the extension of our nervous system." (Macluhan &Fiore, 1968). In my view, computers are "metamachines" which represent a logical endpoint of the Western epistemological tradition. Since the ancient Greeks we have sought what George Boole called the "laws of thought"; we invented logic, mathematics, and formalism during that quest. I believe that when the history of the 20th century is written at the next millennial turn the big story will be the invention of computation. Computation brings the "laws of thought" to fruition and provides a machine for expressing them. Each time you run a different program into your computer, you turn it into a different virtual machine expressing a different algorithm; run a word-processor to instantiate a virtual word engine or a chess program to instantiate a virtual chess engine. How many different virtual machines can any actual computer instantiate? An infinity of them. This is what is meant by describing the computer as metamachine - it is a machine for making virtual machines.

Through the power of digitizing, the computer becomes a "metatool" or "metamedium", mixing many traditional media with ease and creating entirely new modes of expression. Because they empower us to explore the digital, computers will revolutionize not just education but EVERYTHING, producing a cultural tidal wave. The ideas of ubiquitous computing and distributed cognition will converge to refashion world culture. Far from consigning the university to a cultural backwater, this tsunami focuses attention on our mission. After all, as educators we have always been in the information business; we traffic in bits (Negroponte, 1995). We invented logic, mathematics, computation, the computer. We use atoms (physical materials), as needed, to express our intellectual and educational ideals, theories, and content in physical media (books, chalk, video, speech). That is, we have always been tool users. But the physical medium or tool WAS NEVER the point. Even though the digital offers the most universal, expressive metamedium yet, it is still just a set of tools.

Educators and the digital

This brings me to the heart of this paper. Yes, the digital is awesome; yes the university will change, as will society. But we can guide these changes in educationally powerful ways. The key is to keep our sights firmly fixed upon the task (teaching and learning) and not the tools (chat lines, email, word processors, websites, etc.). When it comes to lecturing, for example, I insist on the priority of the lecturer over the video clip, the interactive web presentation, the overhead; lecturing is a form of performance art. The MAIN goal of a lecture is NOT transmitting information but

rather modeling and fostering autonomous learning/motivation. And this requires the lecturer. Of course the lecturer still uses tools (voice modulation, gestures, chalk, overheads, videos etc.) and, I trust it goes without saying, it is incumbent on the lecturer to keep exploring the space of available tools.

Teaching is a craft demanding constant exploration. What would it mean for a researcher or artist to ignore the potential of new tools! So, for the last year I have used PowerPoint for presentations as I playfully look for my "PowerPoint voice". Which fonts and graphics should I use? What about screen transitions, etc.? As I deliberately mix text and various media, I am always astonished at the power of different media to make different points more or less potently. During these explorations I find it useful to maintain focus on my educational goals and to not be swept away by the medium/tool itself. As Postman (1985) argued, media are never neutral. Instead, they offer often unreflected affordances, implicit characteristics which can constrain their use. Thus, for example, television invites (affords) a focus on the visual and the fast-paced; it is not a good medium for presenting complex discourse, as any student forced to watch videotaped lectures can tell you. So as I explore the new technologies, I always try to think "What is this medium good for? What is it poor at?"

Therefore, despite the infinite possibilities of the digital media, each of those possibilities is still a tool to be used effectively, misused, or not used at all. Thus, the digital media offer an infinite number of educational affordances: chat, listserv, word processor, equation manipulator, spreadsheet, course management, etc. Each time we should ask ourselves "What does this tool afford? Mitigate against?" And we should compare this to our teaching and learning goals; "What learning do I want to afford?" and "Will this tool afford that learning or mitigate against it? Is there a better tool, old or new?"

So, IT allows us to revisit instructional problems and discover completely new applications. In the process, IT will, ironically, demand reflection as we become more aware of the processes involved in teaching and learning. I say "ironically" because I rarely hear reflection on the use of chalk, overheads, or handouts even though they are also tools with their own affordances. It is ironic to me to hear colleagues question the value of IT when they may not even be aware that the same questions need to be posed of their existing approaches to instruction. I suppose it is only when we are challenged by the new that we question what we do. Regardless, if IT achieves no more than forcing us to reflect upon the practice of our craft as teachers, it will have already brought us a great gift.

Putting IT together

I close with the student pseudojournal to illustrate how I have put the themes of this paper into practice, While the idea is not new nor is the underlying pedagogical theory, this work illustrates the main themes of this paper. To begin, the instructional content in this case is the need to teach students about the communication of knowledge in psychology. The standard way is by requiring that students write papers and lab reports in American Psychological Association (APA) style. And this is exactly what I used to do in a third-year course on research methods in psychology. In effect I used traditional tools to achieve a traditional goal. But I was forced to reevaluate this approach when I read about the idea of cognitive apprenticeship in a manuscript by Collins et al (1989).

Accordingly, I founded the student pseudojournal BURP (Brock University Research Proceedings) (Mitterer, 1988, Mitterer & Passmore, 2000). Students in the course no longer handed in workto the instructor. Instead they submitted their articles to BURP in quadruplicate. The editor (me) sent three copies out for peer review (to other students in the course). When reviews were received, a decision was made whether or not to accept the article for publication in BURP. Rejected articles (by design, most of the first-time submissions) had to be revised, incorporating feedback from the editor and the peer reviewers. Three major benefits accrued from this approach.

First, students were required to revise their papers using feedback, something they had not often done before. The revision process, imbedded as it was in the realistic BURP context, was more meaningful to students than merely rewriting a paper based on a professor's markup after a grade had been assigned. Almost every student submission was markedly improved by the revision process and many students, expecially weaker ones, reported increased satisfaction with the results of their work.

Second, and often for the first time, students critically read the writing of their peers in their roles as peer reviewers. After reviewing weaker papers, our stronger students acquired insight into why they were getting such good grades. Similarly, weaker students were often inspired by their exposure to better papers. The review process offered all students insight into the form of writing in psychology and the marking process itself, sensitizing them to the role of the professor in judging quality.

Third, the social context of the entire process opened the course up to a dialogue on the forms of communication in psychology that I had never seen before. As one example, students no longer questioned APA style. With multiple papers due for submission to BURP and at least three reviews of peer papers for each submission, workloads increased and students became impatient with submissions not in proper APA style. That is, they saw for the first time that discipline-specific communicative forms are not arbitrary constraints placed upon the writer’s expressiveness but rather stylized communicative forms functioning to facilitate communication.

I always wanted to implement this idea in my introductory psychology course; what better time to introduce students to APA style and cognitive apprenticeship? Unfortunately, the logistical effort was forbidding in a senior course of 30 students much less with 1000 students in a first-year course. This year however, my informal surveys finally revealed that my students all have access to computers, are web-literate, word-process their essays, and know how to use email. Thus, I am hopeful to resurrect BURP this fall or next. While I do not yet know exactly which tools I will use, I suspect I will a) publish products on the web, b) use email to communicate, c) use a word processor for markup, d) use spell- and grammar-checkers, and e) develop file-management software to track it all.

I offer this work in progress as a case study of how to make use of IT. The sequence ought to work this way: First: What content do I wish to teach? Here, communication in psychology. Second: How do I want to teach it? Via cognitive apprenticeship. Third: What tools will I use? Word-processors, email, grammar checkers, the web, and so on. The point is that my choices of tools is guided by a preexisting notion of what I want to teach (content knowledge) and how I want to teach it (process knowledge). Within this framework I can make sensible choices about tools and be less driven by newness, panic, or ignorance. It is not that this approach dissolves my problems, it just

makes them more manageable and, hence, more solvable. In closing, I will say only that the new media do not absolve us of our responsibility to our craft, instead they empower us in astonishing new ways.

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