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The E-learning Imperative[1]

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ABSTRACT

E-learning, and "instruction at a distance," are being widely promoted as an alternative to traditional teaching. The influence of distance learning on conventional instruction has a long-standing history, yet many of the terms in current use, including e-mail, blended learning, virtual reality and e-learning, are poorly understood. The virtual microscope was one of the first on-line simulators ever developed, and it is noted that many of the major developments (including the first-ever Web browser) were the result of research and development in Illinois. The lecture examines the effects of these developments on researchers and teachers of microscopy, sets the concepts into context, and addresses the benefits, and drawbacks, of the new technologies.

COMPUTERS AND THE MICROSCOPE

The mastery of computers dominates our working lives. I'll rephrase that – our lives are dominated by the mastery of computers. Is the computer really the enemy? Are teachers losing out to these pervasive machines? Or is the computer age destined to make learning easier? There is now so much information available at the touch of a button. The development of didactic systems has led to a mushroom growth in e-learning. Indeed, plenty of people have said that teachers are becoming irrelevant: the computer can do the job better.

For those of us who work with microscopes, there is a particular intimacy with these arguments. Today's microscopes are expensive and heavy, and taking them out to the field has never been easy. With access to the Internet, we can show distant students how to observe our specimens and even allow them to focus on a preparation and scan across its surface as though using a mechanical stage. Little wonder people have speculated that this will revolutionize the future of learning, so that hands-on instruction in the laboratory disappears altogether. Click, and the laboratory comes to the student.

This topic is not confined to academia; it has even cropped up on popular television. In the FOX Television cartoon series, "The Simpsons," Homer Simpson is seen to log onto an e-learning site in his quest to become a minister of religion. And which site does he choose? Why the "e-piscopal" site, of course (Figures 1 and 2). He downloads his dog collar, prints off his certificate of acceptance from the "internet divinity school", and there he is – qualified. This is a popular image of e-learning; that it allows no-hope individuals to gain spurious certificates in a subject that they have only superficially addressed.

Microscopists have tended to look warily at the whole topic, for as a breed we are steeped in traditions and know how often some judicious tweaking can al-

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Figures 1 and 2. Homer Simpson, from the FOX Television series, "The Simpsons," downloads his clerical collar from the "e-piscopal" church and is thus qualified to act as a minister of this fictitious Web-based organization. The concept of Internet instruction as offering qualifications to those who hardly deserve them has become increasingly widespread since e-learning emerged. When e-learning is high on the agenda, it is obvious (to Homer) that the e-piscopal church would be the source of authentication that he needs. After "e-mail," e-learning was an obvious term to choose for the new approach to disseminating knowledge. The term is misleading, and (as its founder now concedes) it is probably time to abandon it.

low us to obtain results that the clinical correctness of computer analysis can never provide from our specimens. There is no hope that the subject might just go away. Currently Google turns up 380 million sites for "learning," 180 million for "teaching" and 50 million for "e-learning." Distance learning is big news, and is here to stay.

DISTANCE LEARNING

Distance learning is not as new as we imagine. Back in 1885, John H. Vincent published in his book, "The Chautauqua Movement" (New York: Books for Libraries Press), that "The day is coming when the work done by correspondence will be greater in amount than that done in the classrooms of our academies and colleges." Then, as broadcasting came along, it began to make inroads into education. Between the two World Wars, over 200 universities and colleges set up broadcast-based educational courses. Perhaps it was the novelty of broadcasting, for it didn't last; by 1940 there was only one college-level course left on the air.

In 1926, the British educationalist and historian J. C. Stobart, who was working for the young BBC (founded as the British Broadcasting Company in 1922) wrote a memorandum in which he advocated a "wireless university." Then in 1960, R C G Williams of the Institution of Electrical Engineers of London proposed a "tele-university," which would combine broadcast lectures with correspondence texts and visits to conventional universities. His was truly a "multi-media" proposal.

In 1962, in the educational magazine "Where?," Michael Young set down a proposal for an Open University. Students, for the first time, could become academically qualified through study at home. They would use correspondence courses, broadcast programs, and attendance at summer schools. It would open up high-level university education to the housebound, the infirm, and those too busy earning a living to enroll at university full-time. In the following year, the government of Prime Minister Harold Wilson (Figure 3) produced a plan for a "University of the Air" and the Open University finally opened at Milton Keynes in 1969. The inaugural Vice-Chancellor was Professor Walter Perry (later Lord Perry of Walton) (Figure 4) and the first students were enrolled in 1971. No academic qualifications, examination passes, or university accreditation, were necessary for the new students. The academic world was suddenly available to everyone willing to pay the modest fees.

Although the Open University (OU) initially relied heavily on correspondence, it was quick to embrace television. They transmitted their TV courses at unsociable hours, when the general public weren't watching, and the OU students were teased for hav-

ing to sit by their sets in the early hours of the morning. Once video recorders became available, students could record their courses and play them back at more civilized hours.

DAWN OF THE PERSONAL COMPUTER

Also during the early 1960s, I was cutting my teeth on an Elliott 803 computer at Cardiff, which cost £30,000 (at the time $70,000) and filled a room with transistors, cables and cooling fans. At the same time, a new approach dubbed "programed learning" was being developed. The idea was simple: the facts of a subject were set out in bullet points, and a student had to tick the right "answer" boxes to confirm that they'd learnt the relevant items before turning the page. This system relied on items of knowledge set out in the manner of a computer program. The two approaches – free and open learning and a structured program approach to instruction – offered fertile ground for computerised learning via the Internet.

Meanwhile, home computers were beginning to appear. The public were increasingly enthusiastic! There is a remarkable film clip on at http://video.google.com/videoplay?docid=4796674762025998102 that shows a 1966 prediction of home life in 1999, with home shopping, remote monitoring, and even e-mail up and running. To many of us, the developments could not come quickly enough.

Cost was clearly the problem. What we needed was a cheap personal computer, and that seemed little more than a distant dream. My long-standing friend Sir Clive Sinclair is a noted British inventor, and in the early 1970s he was working on the first mass-production portable computer for the home user. His ZX80, launched in 1975, was the first such machine with a QWERTY keyboard. It sold for £99, a crucial marketing consideration, and boasted just 1 KB of built-in RAM. The ZX81 appeared in 1981 and was improved in many ways. It still had a mere 1 KB of RAM, but it came with everything in a single box. For the first time, commercial software began to appear offering games like "Space Invaders." From there the home computer evolved into the Sinclair Spectrum, with 256 x 192 graphics and up to 48 KB of RAM. Marketing was boosted by outlandish claims about the power of these primitive machines ("It can run an entire nuclear power station!") and they used to produce 40,000 units per month.

Product quality was unreliable, and the sales pitch was always better than the computers. But the dam was broken, and we saw a tidal surge of interest in

Figure 3. The author (left) discusses his microscopical research with British Prime Minister Harold Wilson at the Royal Society of London in 1982. Wilson was Prime Minister from 1964 to 1970 and from 1974 to 1976. He was a firm believer in promoting science and a strong supporter of the Open University in Britain, which was the world's first academic institution to rely entirely on distance learning.

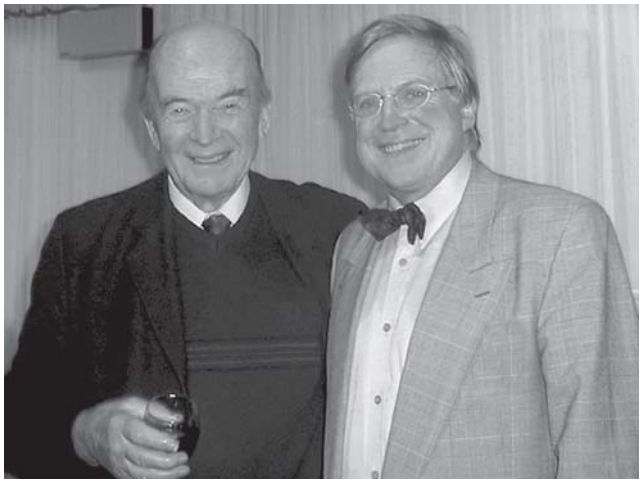

Figure 4. Lord Perry of Walton (left) with the author in Parliament in 2000. Professor Walter Perry was the Open University's first Vice-Chancellor (University President, in American terms). He was granted the title of Lord as a result of his endeavors in establishing the Open University as a reputable academic body for distance learning. This began the move towards higher education without attendance at a seat of learning.

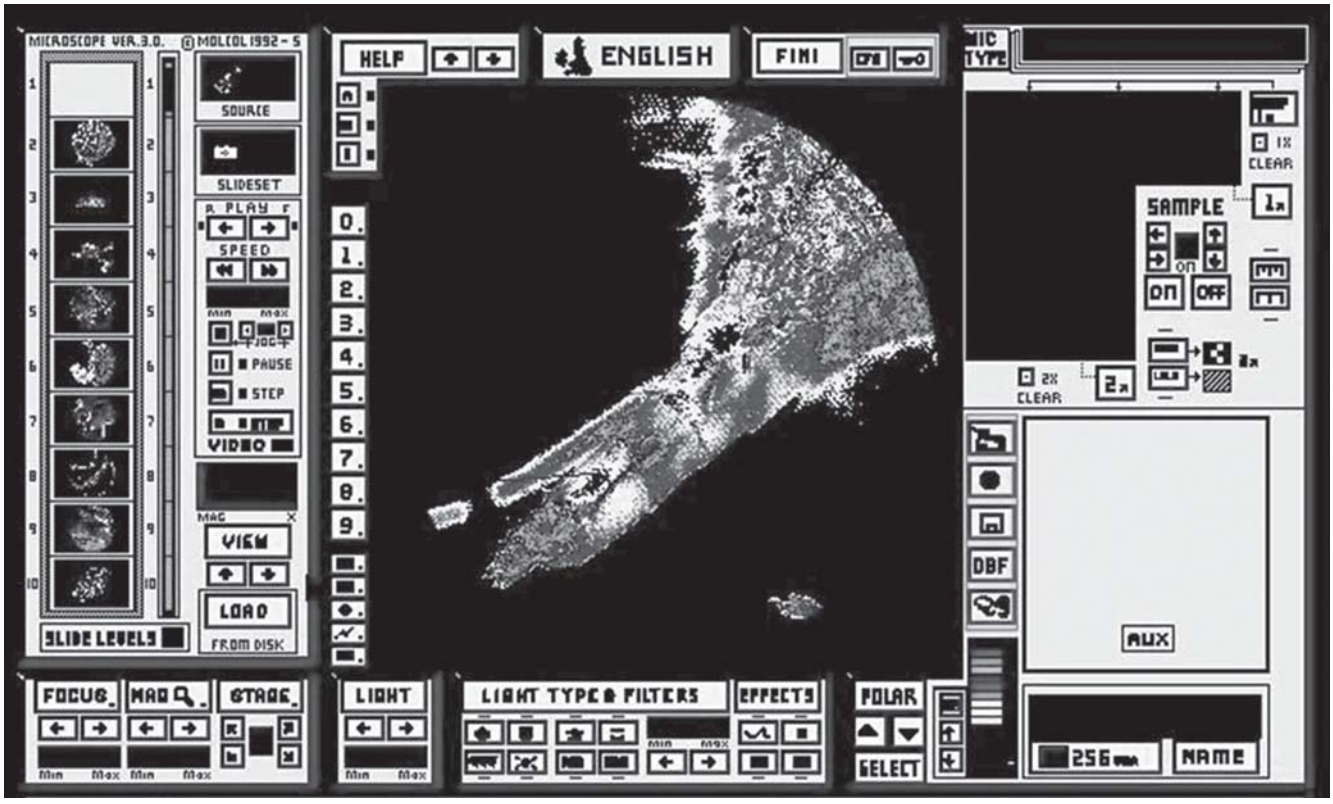

Figure 5. The Microscope for the PC was one of the first-ever virtual instruction sites on the Web. Launched in 1992, it offered a range of specimens and the chance to focus, change magnification, and track across the specimen field. Two specimens could be compared alongside each other. It is still available for download at http://www.microscopy-uk.org.uk/mscope.html.

having a computer, as an everyday item, at home and in the office. During the 1970s, many manufacturers came on stream and the popularity of home computers around the world grew steadily as people realized that they did not have to be large, and neither did they have to be expensive.

THE VIRTUAL MICROSCOPE

Microscopy was right at the front. In 1992 the Microscope for the PC was released (Figure 5). Running in DOS, it offered the experience of seeing specimens under a microscope. It had a full range of controls (via the keyboard) to allow the user to change magnification and to move around the slide at will, and to compare different specimens side-by-side. It was a remarkable innovation and is available in a version that is compatible with Windows XP from http://www.microscopy-uk.org.uk/mscope.html for anyone keen to try it for themselves. It was one of the first teaching simulators in the world, and it took many years before it was superseded.

It is to the credit of the Open University that they did much to develop a site that allowed students to look at microscopical phenomena on-line. The most widely consulted such site is OU's "Virtual Microscope" on http://projects.kmi.open.ac.uk/microscope which is well worth consulting (Figures 6 and 7). They have recently added a Martian meteorite that can be examined by the online visitor. The Open University remains a pioneer of distance teaching. Years later I was given a research fellowship from that university, studying and developing online resources, and I remain proud of the association.

The first Web browser was developed in Illinois and was launched in 1993. Named "Mosaic," it was the first graphical browser for the World Wide Web and was developed by Mark Andreessen and Eric Bina at the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign. You can still download the browser from the NCSA on the following site: ftp://ftp.ncsa.uiuc.edu/Web/Mosaic and experience what we all knew then. This development made 1993 the year in which the Internet

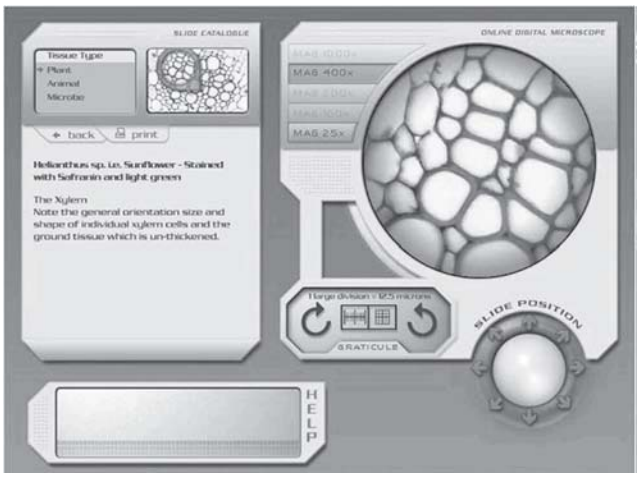

Figure 6. The Online Digital Microscope from the Open University is a resource that remains one of the best available. In this case, the virtual microscope is showing the viewer a transverse section of Helianthus*, the sunflower. Available magnifications range from 25x to 1000x, and one can track across the specimen using the mouse.*

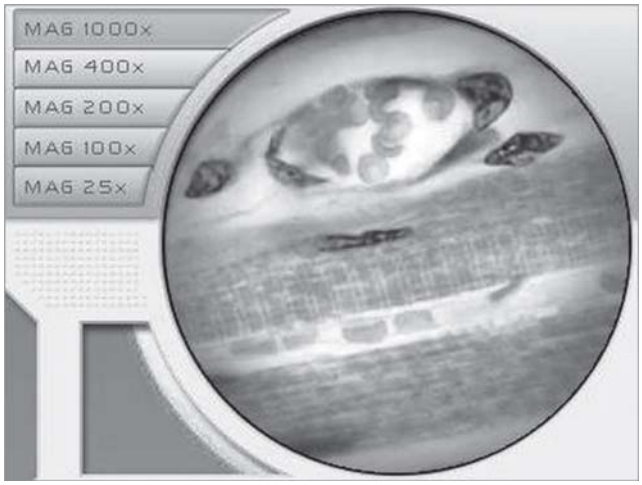

Figure 7. In this longitudinal section of striated (voluntary) muscle, stained with haematoxylin and eosin, details of the banded nature of each fiber can be clearly seen. Note, too, the oblique section of a capillary in which the erythrocytes are also clearly discerned. This shows how useful the virtual microscope in introducing views to students.

became available to enthusiasts (this was the year when I set up my first Internet account).

The Internet itself had existed in primitive form since the 1960's and by the 1970's Internet connections between computers were well established. There was no common protocol, of course, and the system was like an *ad hoc* telephone network. Tim Berners-Lee worked out the rudiments of the World Wide Web (which runs across the Internet) while working at CERN, Switzerland. Walter McCrone used to take a perverse delight in working on Christmas Day, and would have been delighted to know that it was on December 25, 1990, that Berners-Lee sent the first HTTP communication to a colleague in Switzerland. This launched the World Wide Web. Within a few years, the Web brought the Internet to the scientific community.

AN IMAGINED REVOLUTION

Since that time the Internet has become all-pervasive. Much of the novelty of on-line access and instruction is misunderstood. Worse, it is overstated by practitioners, eager to maintain a hold on the market. The abundant ease of access brings us close to the greatest publications of the age, but that is not all – it also brings us close to the horrors of poor education and limited understanding that are a hallmark of today's Western society.

YouTube will show what the present-day enthusiast makes of the microscope. In the last year, some good sequences have been uploaded, but for many years the quality was almost universally poor. Images are out of focus, illumination is poorly adjusted (even completely off-center), and the commentaries leave one dumbfounded. "Gee, that's awesome," says a typical commentary. "These critters, dunno what they are but they're so cute." One sequence of *Paramecium*, for example, shows the most poorly resolved organisms (see http://uk.youtube.com/watch?v=SPTvcJnUfVI) (Figure 8).

And the inanity is not the only problem, for people try to use the instrument in self diagnosis. On http://www.youtube.com/watch?v=_ijDDXFCG5A is a sequence of blood under darkfield microscopy (Figure 9). The commentator says: "My blood looks kinda sticky and that could be either not drinking enough water or could be due to inflammation. Could only find two bacteria in my blood. There are also not so many white cells in my blood, and they aren't very active, so that's not a good sign. There's also big chunks in my blood, they also look like big worms, twisty worms, and they said it could be lack of protein." (The chunks are actually hairs).

Internet sites bring us close to information, good and bad. People have raved over the new wikis and blogs, with online video and podcasting . . . but, for all their novelty, in many ways they are simply repack-

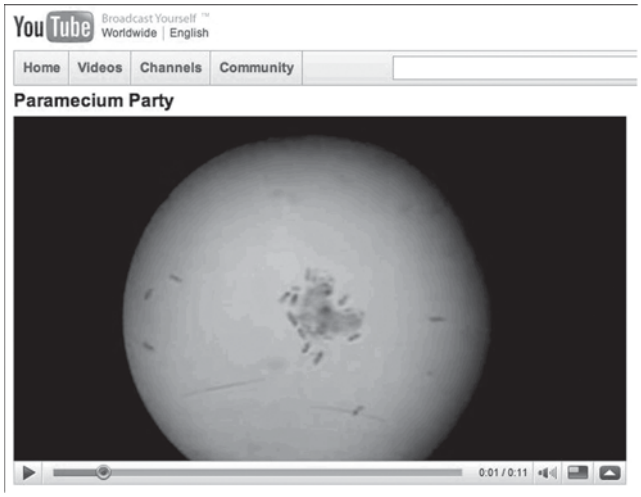

Figure 8. In this YouTube sequence, some small images of poorly resolved protozoa can be discerned. These sites remind us of the urgent need to bring decent standards of microscopy to schoolchildren. This microscope setup has poor color correction, uncertain focussing, dirty lenses and a badly adjusted condenser.

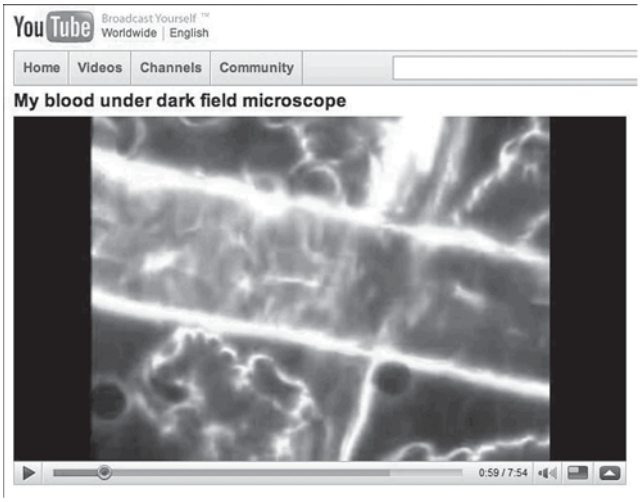

Figure 9. Erythrocytes are seen in the background of this You Tube sequence, while prominent fragments of human hair dominate the field of view. Note that the erythrocytes show extensive crenation, a testimony to the specimen being subject to evaporation during its time under the coverslip. The hapless amateur microscopist was looking for bacteria, and noted that the white cells were few and far between. That seems normal to us!

aged and accessible versions of familiar concepts. Search engines like Google are miraculously efficient, and sensible scientists use them all the time; but searching itself is hardly a novelty. Google is nothing more than a time accelerator. It might have taken you decades to search papers for an isolated fact, and now – through this miraculous system of Web bots and spiders – the answer can appear in a millisecond. As I discussed in an article for *Laboratory News* in the UK (January 2006, p. 16) it is the speed that is the miracle, not the principle.

The World Wide Web has a two-way function, and the principle of Web 2.0 is that anybody can contribute their own input. The wiki – a site that allows independent people to input – is older than you might think. It was set up in 1995 as WikiWikiWeb by a computer enthusiast named Ward Cunningham. It is said that the word derives from the Hawaiian *wiki-wiki*, meaning "fast," but it was actually the name for the Honolulu airport shuttle-bus that Cunningham saw in 1995.

Since encyclopedias are written by specialist authors, there is much appeal in a site that allows anyone to contribute. Although this offers the private enthusiast a public place, it is a mixed blessing. They say that the joy of the Internet is that it allows you to publish anything you wish, without the intrusion of an editor. Yet I know from experience that the prime purpose of an editor is to stop people from publishing nonsense. Abandon the editors, and the nonsense proliferates. Wikipedia is widely used by the young to cut and paste material for assignments and essays, but I never rely on it. When Google offers access to original research, why should anyone sink to amateur distillations that may (or may not) be correct?

As for the digital images, blogs and podcasts, well, there have long been photographs just as there is a long history of diaries and broadcasts. Not one is new. The means of delivery is novel, and the speed of access – and retrieval – is quite close to instantaneous, but we are still retrieving the same old images (and still reading the words in the same, time-honored way). This equally applies to the myth of e-learning. There is no such thing as e-learning. The learning process proceeds much as it used to, and we read (from the screen) as we have long done from books and journals; we watch video sequences just as we used to, but without the need for the cassette or the projector. People listen to commentaries on the computer, rather than hearing them live in the lecture room. So the access to teaching materials has been revolutionized, and we have

many new ways in which to teach, but the learning is still done in much the same way.

Another of the supposed benefits of the Internet and e-learning is "asynchronous learning," which defines how a student can learn information at a time and place that is different from the original presentation. Excuse me? What is new about that? Asynchronous learning takes place when a student reads a manuscript or a book, and has existed for centuries. Asynchronous learning is what happened when a student played a sound cassette or watched a video. It is asynchronous learning on which the Open University students based their studies, when they recorded late-night instructional programs as they slept.

A similar debate centers over e-learning versus blended (earlier called hybrid) learning. In the modern world, it is said, all that we need is e-learning; and the counter-argument is that blended learning is best. Blended learning is defined as a combination of formal teaching with the use of Internet-based instructional materials. Clearly, a combination of private study and face-to-face contact with a teacher is likely to be better than either on their own. I am astonished that the notion of blended learning was ever coined, for it is how everyone learns everything best. There was never a debate (when radio was invented) that we should use that medium alone for instruction, and abandon books. Nobody suggested (when film came along) that this would now supersede radio and print.

But the idea of future supremacy for e-learning, until it causes the extinguishment of universities and colleges, has become widely promulgated. Its proponents (of course) are those who have a vested interest in the topic, and seek to promote their professional preoccupations above any objective appraisal that would set the topic into a more balanced context. And there is a lot of money to be made: grants and tenure are available for people who want to raise the status of any high-tech protocol in the modern world, for this is where the sales of future products and software originate.

There is much to be made out of this line of business. Web pages (Figure 10) extol the virtues of the teacher, and are as assiduous as a double-glazing salesman in the way they press the viewer to sign up. And there is even money available for people posing the most basic of questions. Does anybody in this room doubt that blended learning works? In Florida, academics obtained support for a research program that lasted for years, asking this obvious question and answering it at exorbitant length. Look on the Educause Connect Web site (document: Learning ID: ERB0407) and you will read these words that prove the point:

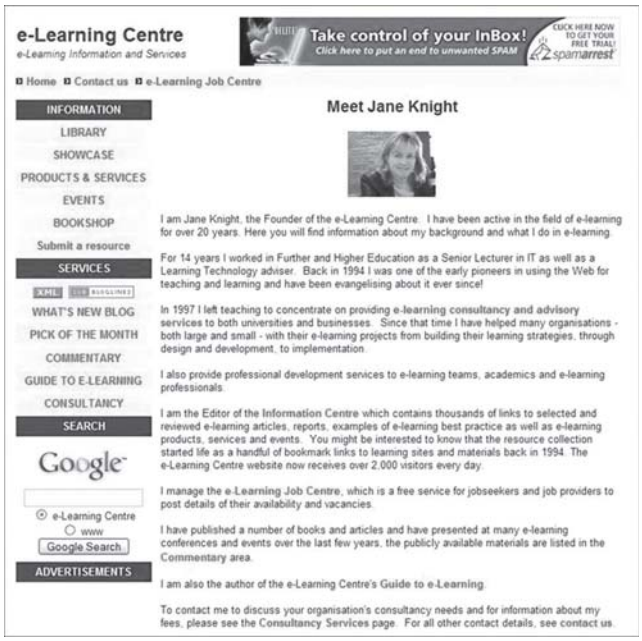

Figure 10. Pages like this serve to extol the virtues of the individual, rather than the medium – and is a fashionable source of revenue. In this example, Ms. Knight painstakingly lists her achievements in the hope of gaining new clients for her e-learning business. It must be said that the repeated, prominent use of "I" throughout this page does hint at self-awareness to a remarkable degree.

"Seven years of research at the University of Central Florida (UCF) has found that blended courses – those that combine face-to-face instruction with online learning and reduced classroom contact hours – have the potential to increase student learning while lowering attrition rates compared to equivalent, fully online courses." You could equip a microscopy laboratory for the money that cost, and do it in a lot less than seven years . . ..

These concepts – e-learning, synchronous learning, blended learning – are new terms indeed; but they describe age-old processes that are very far from novel. The idea that they avoid the need for students to attend a college or university is a fallacy. In Britain, my view was highlighted in the *Times Higher Education Supplement* (November 18, 2005, p 2) when their reporter Anthea Lipsett interviewed me about my professorship at Leicester University. You may show students all you wish on-line, but to come to a center – as at the McCrone Research Institute – and sit with an instructor who is experienced, and knows the procedures, cannot be replicated. On-line learning, or training in simulators, gives the student an unprecedented way

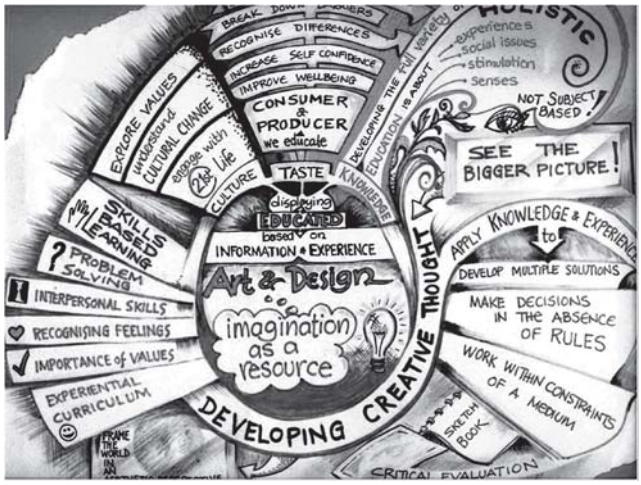

Figure 11. The technique of mind mapping involves drawing related concepts in a two-dimensional "flow chart." Software is now available for this technique for use in e-learning, but as this example shows, felt-tip pens allow a freedom of expression that a digitized protocol would not easily allow. Sometimes the manual systems remain the best. (Illustration courtesy of Oban High School, Oban, Scotland, UK)

of learning repetitive behaviour. This saves the instructor's time, allows the students to pace themselves comfortably, and gives them the chance to repeat something until they are comfortable with it. This is an adjunct, it supplements the teacher's input – but it does not subvert or replace it.

Computers have their limits. I once chaired a presentation by a specialist in graphics software, who insisted that he could do anything on his computer "better than it can ever be done by hand." When the discussion time came along, I challenged him – and he responded with even greater confidence. "Very well then," I said. "Let's see your signature." He tried, but failed; and there are occasions when a manual method is still best. Mind maps, a widely popular method of brainstorming that leaves me cold, can be drawn up using dedicated software – but as the example alongside shows, nothing is as quick, as responsive, as easily modified and as flexible as drawing on paper with pens (Figure 11).

The popularity of the computer has granted them almost magical powers. "The computer," people say, "can do things no human can ever do!" yet this is equally true of a thumb-tack or a pair of scissors. They say that computers are approaching living organisms in their abilities. The foolish claims for "artificial intelligence" are a case in point. Recently I heard a lecturer on microchips tell his audience that they were now processing information "almost as fast as a rat's brain." Another academic says to me that he is working on computerised reading systems for data acquisition. "It functions almost as fast as a cockroach," he averred. Such people know that, more often than not, they can make such irrational statements and create the impression that an electronic super-brain is just round the corner. There is a sense that computers are rivalling humans in their capacity to perform miracles.

I can give you a test to show when computers can rival a living cell. Put three computers in a room, and smash the middle computer with a hammer. Now seal the room and go home for the weekend. On Monday morning, if the computers are truly approaching the abilities of a living cell, then the middle computer will be mended and running perfectly.

When they first appeared, a computer was often nick-named an "electronic brain." It is nothing of the sort – "electronic moron" more like. The computer is unbelievably fast, and it is expandable; but it has nothing that allows you to see it as somehow equivalent to a living system.

ALPHABET SPAGHETTI

Just as the functioning of a computer is unimaginably complex, the language computers employ – the alphabet used in their functioning, if you will – is of incredible simplicity; it is a binary code, consisting of just two characters, 1 and 0. If I may put on my hat as an adviser to Guinness World Records Book over many years, I may mention that the longest alphabet in the world is Khmer (from Cambodia) with 74 letters including 35 consonant symbols; the shortest is Rotokas, spoken in Papua New Guinea, with just 12. From these an entire cultural literature is spun. The musical scale boasts eight notes (13 if we count the semitones on the "black notes') yet this has imposed few limits on the variety of music. There are only four characters in the language of the genetic code (A, C, G and T for adenine, cytosine, guanine and thiamine) and look at the incredible variety in the world of living organisms. The two characters of the digital alphabet are the final example I cite – the simplicity connotes infinite variety. The fewer letters, the less there is to change in the quest for novelty, and the faster calculations can proceed. The simplicity is the key, not the problem.

Yet it is in the use of language – our human language – to describe the machinations of computers that our real problems lie. Computer programmers are not often literary individuals, and they do not always un-

derstand the terms they use or those that they coin. For example, a single document or an image in a computer is dubbed a "file." One cannot imagine the closeted life of the computer wizard who thought of that! A file is something into which documents (or photographs) are stored. The photo itself isn't a "file."

Error messages flash up to warn that you've carried out an "illegal" act. Illegal? Can the police really be ready to raid the room? In reality, the computer has crashed through some bug in the software; it's just the wrong word. On PCs there is a "recycle bin." I beg your pardon? It is the trash can. You can sometimes retrieve a lost document that was inadvertently deleted, but this is nothing like "recycling." It's the wrong term again. The computer is identified by the Microsoft specialists as "My Computer," which has caused confusion for tyros using other people's; and by what bizarre twist of mentality do you click on the "start" button to stop?

What makes it even worse is that the terms keep changing. What was once a "directory" in Microsoft Windows is now a "folder." And we spend too much time in keeping up with new operating systems and software, which are rarely completely compatible at an intuitive level with what went before. We were using Office 2007 back in 2006, and Vista as soon as the beta was available. Unless you keep up with the latest trends it is deceptively easy to be left behind; and mastery of the current terminology is at the heart of the problem and it wastes valuable time.

The term "e-learning" has its origins in "e-mail," of course, and that was always a mistake. It is not the *electronic* nature of the hardware that determines the essence of the medium, but the fact that the communication is *digital*. It is the digital nature of data that determines its ability to be transmitted, modified and so easily stored. An old-fashioned telegram was "electronic mail" of a sort.

This digitization of data is the single development that we need to embrace and understand. When first I advocated the digitization of scientific collections in London, a decade ago, I received blank looks until I explained in detail what it implied. Nowadays, everything is being enthusiastically digitized as rapidly as possible. There is a substantial community of people who print off e-mails and then file them like letters. This is a fundamental abnegation of the benefits of digital data. Only e-mail allows you to search a thousand documents for a single word, or forward a complete message and attachments without degradation of quality. The hard copy of an e-mail is just a picture of words: use it again, and you'll have to re-key every character.

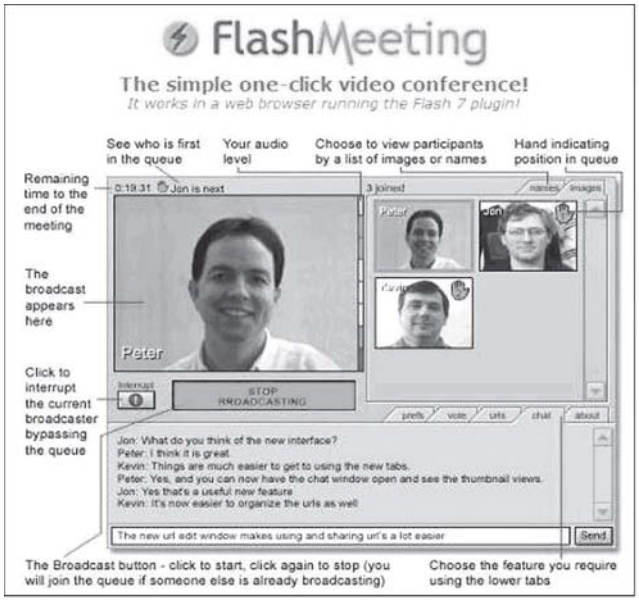

Figure 12. There are many video conferencing programs now available. This is not new – we have had video telephones since the 1960s. The conferencing system is used less often than one might expect, because we still find that a face-to-face meeting provides far more useful interaction than can ever be achieved through a digital platform.

COMPUTERS IN CONTEXT

Our microscope slides can now be digitized and transmitted round the world. Your old card-indexing systems can all be digitized and searched in a second. And yes, you can use the results to give experiences to remote students, or to people out in the field, without any need to carry equipment with you. But what you can thus show is always limited – and never enough to convey the whole picture.

And it does not obviate the need for teaching. Microscopes are instruments that need to be felt, caressed almost. There is a refined sense of delicacy in the way we handle our specimens, a certain choreographed precision in the way we steer the microscope; there is a technique of administering a drop of reagent, or performing a quick and revealing flame-test. The specimens we examine are not the crisp and detached fragments people imagine, but are part of a continuing process of development and interaction.

We can hardly overestimate the value of the Internet as an easy means of access to long-lost digitized documents, and as a means of obtaining, sharing, manipulating and archiving images, videos and sounds. It is a priceless innovation; none of us here can

imagine life without the hourly benefits it brings. But let us keep the computer in proportion. Computerized learning is an adjunct, nothing more. And computerized microscopy is something everyone needs to understand, but to keep in proportion.

Nothing can replace the closeness of an instructor who knows their stuff. No computerised system of analysis can supplant the wise eye of a microscopist who knows the tests and can painstakingly tease out the story. There is no analytical result from a printout that can provide the insight and sense of context that, to an experienced microscopist, is second nature.

There was a view that "virtual reality" would replace, in many ways, our view of the world. There was talk, in Bristol UK, of a "virtual zoo" that meant you would never have to travel to see wildlife in the flesh, for the simulation would work as well. Well, the computer may be a marvellous thing, but it's not that good. Can anyone imagine that watching a DVD on a Blu-ray player with surround sound can convey the impression of being present in the audience at the concert? There is no substitute for the experience of being there, no matter how comprehensively it can be supplemented by the proper incorporation of digital resources.

The founder of digital online learning, Jay Cross, recently said: "I am actively backing away from the term e-learning." No wonder: the belief that the Internet would remove much of the need for human interaction is clearly false. My great friend Professor Curtis Bonk of Indiana is a wonderful expositor on the subject, and has just published a book on the topic. What was that? A book? If the Internet worked the way they say, then there would be no need for a book in the first place. It would be a blog, or a site, a wiki perhaps.

Curt and I have often met to discuss these topics, and he is a rich fund of beautiful insights. And yet, and yet; we *meet* to have our discussions (Internet communication doesn't even come close). When there are new areas of thinking to present, then we arrange an *en-face* conference to air the views (teleconferencing cannot conceivably replace it). The truth is that the new e-learning is the same old learning, with the same need to read, to write, to compose, to argue, to analyse. The Internet provides access to the data, but it's the participants who provide the brains. It is the same with teaching microscopy. The Internet (or a DVD in a computer drive) may be a stunningly rich source of facts and figures, sights and sounds; but it takes the teacher to impart what it means, and make it memorable. Acquiring knowledge is easy. Retrieving it, and making use of it, is something you need to teach.

E-learning offers everyone in microscopy wonderful new horizons to explore. Although the Internet is better than any library for the retrieval of information, none of this will ever remove the overriding need for gifted and kind teachers to teach. You should dismiss the vogue for a new emphasis on "learning," which simply transfers the onus from the teacher to the taught. You don't learn brain surgery or master how to drive by learning through trial-and-error on your own, but by being taught. We all remember gifted teachers from our past, and it is usually they who set us on our professional paths.

It is popular to cite research saying that lectures don't work. Why? Because surveys have shown that most people retain little from the structure of formal lecture, and so we abandon them and move to something digital instead. This is senseless, unless we ask why information and ideas are often not retained by the members of a class. The reason is that many lectures are poor; they are unstructured, unmemorable, unconvincing and incoherent. Good lectures are crucial, and we remember them all our lives. We all know that teachers matter. Never forget that.

And is the use of distance learning so hard to set in context? I shall end with another quote. "The correspondence system would not, if it could, supplant oral instruction, or be regarded as its substitute. There is a field for each which the other cannot fill. Let each do its proper work." How true are those words. They were uttered by William Rainey Harper, the first President of the University of Chicago, speaking in 1886.

They now say that we live in an information society, but in my view, there is far too much information, and far too little attempt to make sense of what it means. Long live the Internet. Thank heavens for computers. Used in context, where real people use their wisdom, humanity and experience to infuse learning and excitement into a new generation of students, these are offering us untold benefits. But no microscopist worth their salt will imagine for an instant that this obviates the need for the insightful eye and the keen mind.

This is what matters above all. This is the flower. The computers are just high-speed fertilizer in a box.