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Open Educational Content for Digital Public Libraries

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Many experts on education and information technology contributed their views for this report, in email exchanges and conversations. Nonetheless, unless otherwise indicated the views expressed herein are solely those of the author, and do not represent those of the contributors, the Hewlett Foundation, or the institutions with which the author is affiliated.

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INTRODUCTION

Carved in granite, over the doors of the Carnegie Library in Pittsburgh, are the words "Free to the People." Andrew Carnegie was the predominant benefactor of what came to be known as the *free library movement*, which began in the 19th century and continued into the 20th. Other ultra-rich of the day participated too, as did many hundreds of local philanthropists on a smaller scale. As a result of their efforts, communities large and small were provided with facilities: between 1896 and 1925 alone, public libraries in the US grew from around 900 to nearly 4000.[1]

Many have pondered how a similar movement for the 21st century would address itself to the information commons formed by the World Wide Web. Not so long ago, when simply making connections to the Internet[2] seemed the most important barrier, the emphasis was on funding *universal access*. Today, as the costs of computers and communications have continued to fall, access is a less pressing problem. (That said, high-speed "broadband" access can still be comparatively scarce, even in wealthy areas. And access of any kind remains an issue for the poor.)

This report concerns itself with the scarcity of content rather than connections. It may seem an odd emphasis at first, in a world that is closing on 10 million web sites and billions of web pages.[3] Certainly the growth in usage does not suggest a deficit: more than 60 percent of the US population uses the Internet now, up from around 45 percent just two years ago.[4] Though the market penetration worldwide is much lower on average, the scale of growth is still impressive: according to some projections, today's user base of around 500 million can be expected to double within just a few years.[5]

Despite such expansion, the Internet remains something of a disappointment to educators, particularly those that hope for both a transformation of the educational process and a significant corpus of free education content. True, there is considerable use of the Web

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[1] See http://carnegie-libraries.org/

[2] Formally, the Internet (capital I) is the worldwide network of computers – or more precisely, the network of networks of computers – connected via TCP/IP protocols; it is the physical infrastructure underlying the Web. The World Wide Web – WWW, W3 or "the Web" – is the collection of resources accessible over the Internet using such protocols as HTTP, FTP, Gopher, Telnet, et al. Though it undoubtedly offends purists, these terms have become interchangeable in common parlance, and are used interchangeably in this report.

[3] See statistics at, among others, "Web Characterization," *Online Computer Library Center* at http://wcp.oclc.org/

[4] Amy Harmon and Felicity Barringer, "Investors May Have Repudiated the Internet, but Consumers Have Not" *New York Times* (22 July 2002) at http://www.nytimes.com/2002/07/22/technology/22NET.html.

[5] See "The World's Online Population" at http://cyberatlas.internet.com/. It should be noted that the predominant Web application by far remains email, with the related applications of chat and instant messaging growing fast.

for *e-learning*, transmitted from a hoard of *virtual campuses*.[6] The degree to which such efforts reflect educational innovation – or mostly uninspired "bolting on" to conventional methods – is a subject of much debate.[7] Regardless, high-quality *free* content remains hard to find. As in the bricks-and-mortar (and paper-and-ink) world, digital education material exists, for the most part, for those that can afford to pay for it.

Is there any economic-institutional model that could make it otherwise? The Web's great strength is its ability to deliver content on demand at a very low cost, now that the Internet infrastructure is in place. Equally, it can be a comparatively cheap exercise to host a very large quantity of digital material – a *digital repository*,[8] similar to that contemplated for the Rice Connexions project can be operated for around $1M per year.[9] Content production isn't cheap, however. Despite an ever-growing suite of software tools for authoring and assembly of digital content, it can still be a very expensive proposition to develop first-rate materials – more than $1M for a single course.[10]

Commercial publishing firms can sell their output to recoup the costs of content specialists' and instructional designers' time, as well as that for materials, marketing and distribution. Colleges and universities are often the source of the content specialists – generally known as professors – and that professional association can contribute a brand to the educational materials more important than the publisher's. What would motivate more professors to turn their talents to product of free educational material instead of partnering with vendors of pay-to-use material? What could motivate the institutions that employ professors to "incentivize" such a switch?

Colleges and universities now support and motivate their content specialists to produce a substantial volume of "free" research content. One could say that's just what universities do – it's their duty to advance the frontiers of knowledge. On a more instrumental view, research output is the key to faculty promotion and tenure because it is seen as critical to institutional reputation – from which flows more research grants, higher-quality students (that evolve into a high-donating alumni), and so forth. No commensurate benefits are

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[6] A "sampler" of virtual campus links is provided in Appendix A of this report.

[7] See for example, Carol Twigg, "Innovations in Online Learning: Moving Beyond No Significant Difference" Monograph 4, *The Pew Learning and Technology Program* (2001). at http://www.center.rpi.edu/PewSym/Mono4.html

[8] The technology and terminology for digital content production and delivery is examined in some detail in Appendix C of this report.

[9] Rice Connexions project budget documentation, from reports to the William and Flora Hewlett Foundation.

[10] Large-enrollment courses at the UK's Open University can have production costs running from $2.5M to $3.5M. Source: David Kirp, personal communication. In many respects, digital materials have a cost structure that is the inverse of paper: Digital is expensive to produce, cheap to distribute; heavy paper tombs are expensive to print, and to ship around.

perceived from investments in pedagogy, ubiquitous trans-institutional rhetoric about the importance of teaching notwithstanding.

If the production of digital content for teaching – particularly free content – is to expand substantially, there must be mechanisms to establish a link to fame and fortune that was not perceived in a pre-digital world. How that might be done is the central question this report addresses, in the context of examining the movement for *open educational content.* Understanding that movement requires delving into the history of what may seem, on first pass, a totally unrelated field of endeavor. The reader's patience is requested….

THE SOFTWARE MODEL

Open source. Open content draws both its name and, to no small degree, its paradigms, from the history of *open source software*. Software is typically distributed in a *binary* format – sometimes called the *object code* – ready for copying to the appropriate file directories or folders of a computer as part of the installation process. The binary is the finished product, suitable for "reading" only by the computer. The *source code* for that binary – the instructions written by the programmers – is not usually provided.

Most of us would not ever want the source code. We care only that the software works as is. But other programmers can inspect the source code to fix problems and create improved versions. Such efforts could be motivated by a programmer's immediate work responsibilities, such as a modification to meet an employer's needs. It could also be motivated by a sheer love of programming, and a desire to participate in a collective effort to improve software for everyone – the classic definition of a *hacker*.

Hacker is a label that has increasingly been applied to those advancing destructive computing efforts – such as production of viruses and worms. (Properly, those are *crackers*.) In fact, over the last 30 years the creative output of hackers has resulted in some of the most important and common software in use today. Open source software includes Apache, the dominant web server software[11]; Linux and the various Berkeley Software Distribution (BSD) evolutions of the UNIX operating system; and the family of TCP/IP communications protocols on which all Internet traffic relies.

Independent and corporation-affiliated programmers have played major roles in such efforts, but the dominant contributors typically come from universities. Open source exemplar Linus Torvalds began the Linux project while an undergraduate student at the University of Finland; Richard Stallman's group at MIT developed the GNU components, many of which became part of Linux; the BSD releases of UNIX, other pieces of Linux, and the TCP/IP protocols all hail from UC-Berkeley.[12] While that

[11] With some 60 percent of the market, Apache controls more than twice the business of the rival product from Microsoft. See http://www.netcraft.com/survey/.

[12] See David Bretthauer, "Open Source Software: A History" *Information Technology and Libraries* (March 2002) at http://www.lita.org/ital/2101_bretthauer.html for a more detailed treatment.

alphabet soup of software may seem hopelessly abstract to most readers, the bottom line is that today's Internet could not function without these programs.

Open source licenses. Open source should not be confused with several other variations of low- or no-cost software. *Shareware* is try-before-you-buy software, distributed for free but with a requirement for payment of a (typically small) fee if the product proves suitable. *Freeware*, as its name implies, carries no fee at all. But neither freeware nor shareware typically comes with a copy of the source code (even if one remembers to pay the fee for the latter), to open up the program's algorithms for inspection.

Open source is not *public domain software* either. Open source carries a copyright, but one with a particular set of attenuated protections. In Richard Stallman's GNU version of such a copyright – using an approach he termed *copyleft* – anyone may use, modify or redistribute the program's code, or any programs derived from it, but may not change the terms of the copyright for subsequent uses. In particular, one may not convert an open product into a proprietary one by a more restrictive copyright on derived products.[13]

Other open source approaches take a more tolerant approach to commingling with commercial efforts, and to the particular prospect of commercial works derived from parts of open ones. Minimal licenses modeled on those from the BSD and MIT open source efforts, for example, place almost no restrictions on downstream uses, requiring only retention of the original copyright information in subsequent works (thus guaranteeing credit for the original source work).[14]

The dozens of open source model licenses derive their particulars in part from partisans' differing philosophical notions of what is correctly implied by "open."[15] Variations also arise from different notions about the practicalities, particularly the difficulties of enforcing copyright restrictions. Common to all, however, is this core belief:

> When programmers can read, redistribute, and modify the source code for a piece of software, the software evolves. People improve it, people adapt it, people fix bugs. And this can happen at a speed that, if one is used to the slow pace of conventional software development, seems astonishing.[16]

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[13] Stallman embodied his copyleft concepts into a model agreement, called the General Public License (GPL). Stallman first used the GPL to copyright (copyleft) his GNU software. Hence the abbreviation GNU GPL. Full text of the GNU GPL can be found at http://www.gnu.org/copyleft/gpl.html/.

[14] Copies of all the major open source license models can be found at the Open Source Initiative site, at http://www.opensource.org/licenses/.

[15] Stallman's philosophical expressions can be found at http://www.gnu.org/philosophy/philosophy.html.

[16] http://www.opensource.org/index.php

Open source communities. Typically, open source efforts have begun with a single author or a very small core of developers; subsequent refinements are the province of larger groups. In principle the continuous quality improvement process could be entirely democratic – viz., anyone who so desires can makes changes, and distribute those changes too – but that is rarely the case in practice. Rather, the original developer(s) serve a coordination function, vetting changes and making decisions about release of "approved" new versions.[17]

After 30 years of experimentation, there is still no consensus about the optimal size for or hierarchical rigidities of such communities. Advocates of large, loose collaborations can assert, for example, that the "free, amorphous Linux culture has attracted orders of magnitude more cooperative energy than the tightly organized and centralized BSD efforts."[18] Devotees of more controlled approaches, such as those involved with BSD, can retort that "there is a lot of code in Linux that was hastily written and would never have been accepted into a more conservative operating system."[19]

The answer no doubt depends in part on the scale of the particular programming task, and on the management capabilities of those in charge of coordination functions. It also depends on how one weighs the speculative cost of forgone improvements (due to tight controls) vs. costs from improvements that did not represent improvement (due to loose ones). Whatever the community's scale, the communications capabilities of the Internet, and ever-improving software to manage "version control" of large collections of software components, have dramatically lowered the transactions costs of group collaboration. Thus bigger, more distributed groups are more practical than they once were.

Open vs. free source. The primary reason for using open source products is not that they cost less than proprietary products, but that they are better by dint of all the persons who have worked – and are still working – to improve them. Open source products do tend to be cheaper, for the obvious reason that one cannot charge a large price for what anyone can copy for free. But low is not necessarily no cost. Open source products may be bundled with other things for which a fee is charged: textbooks and technical manuals, and technical support from humans, for example.[20] Such services are critical, because the on-going support costs for software are typically much greater than those for buying it in the first place.

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[17] Eric S. Raymond's essays on this process are among the most commonly cited. See "The Cathedral and the Bazaar" at http://www.firstmonday.dk/issues/issue3_3/raymond/ and "Homesteading the Noosphere" *First Monday* (5 October 1998) at http://www.firstmonday.dk/issues/issue3_10/raymond/.

[18] Eric S. Raymond puts himself in the camp of maximum openness in "The Magic Cauldron" (July 1999) at http://www.tuxedo.org/~esr/writings/homesteading/magic-cauldron/

[19] "FreeBSD vs. Linux vs. Windows 2000" at http://people.freebsd.org/~murray/bsd_flier.html.

[20] As, for example, the various commercially packaged versions of Linux. See, e.g., Red Hat Software's version of Linux at http://www.redhat.com/.

Partisans who prefer the label *free software* for this movement (such as GNU's Stallman) like to stress that the term means "free-as-in-speech rather than free-as-in-beer." The freedom comes in being able to inspect software to know how it runs, to locate otherwise hidden problems and correct them, and have a much more stable computing environment as a result. (*Open source* emerged as an alternative label, rather late in the movement's history, in part because this distinction about the meaning of "free" eluded so many.)

Given most organization's dependence on computers, anything that reduces software risks is a great benefit. Equally great may be the benefit that comes from reduced dependence on a particular vendor of that software. Changes in software are usually time-consuming and expensive for an organization, notably because of user retraining. Instead of being subject to the whims of a single supplier, which may discontinue support for a product at any time (or change its price), open source users can rely on a broad community of maintainer-developers.

Open source economics. Much has been written about the motivations of programmers who donate their time to open source efforts. All of the explanations are variations on the notion of a *gift culture*.[21] In such a culture, reputation and sense of self-worth is tied to one's contributions: you are what you give away, not what you hoard. Academia offers its own version of a gift culture, notably in the production of peer-reviewed research. It can hardly be surprising that most of the prominent open source contributors have academic roots. Universities offer hackers both the physical necessities for such work, and a culture that values that kind of creative endeavor.

This is not to say that no economic benefits attach to participation in such a gift culture. Programmers contributing to open source projects may advance their employment prospects by making particularly notable efforts, just as may academics for their "free" research. Few are immune to the siren song of consulting fees or a more lucrative job. (Hackers in the academic fields of computer science may even have the open source efforts viewed as research output, with the concomitant connection to promotion and tenure.) But any economic benefits are seen as side effects, rather than the goal of participation. The ideal is to be known as someone who produces innovative fixes and extensions to the software.

So much for individuals, but what of organizations? Occasionally, companies producing software decide to open up their products' source code, rather than keep the underlying algorithms secret. Why would they ever do so, given what would seem to be an inevitable decline in economic returns? It amounts to a gamble that this step will increase market share and the prospects for selling related services enough to compensate for losses on sales of the product itself. For example, a company might make its money on technical support, rather than charging for the software. The more users, the more need for (and revenues from) such support.[22]

[21] All of Eric S. Raymond's essays include variations on this theme. See other footnotes.

[22] This strategy is an old one, and can be an effective method for profit-enhancing price discrimination according to intensity of demand. When a company gives away the razor and sells the razor blades at a

Remember that the central virtue of open source is its allegedly greater reliability due to mass peer review. Open source may make the most marketing sense for software that is particularly critical to business' functioning, where software failures can be particularly catastrophic (or where being locked in to a particular vendor is seen as particularly risky.)

Providers of proprietary software have an incentive to advertise their wares, either because they can sell it directly or, as in the example above, sell some other product bundled with software they have open-sourced. While much is made of the malign nature of advertising, it does serve the function of informing consumers about available products. Open source software arising from non-commercial development communities must rely much more on word of mouth, or the economic incentives of those who find ways to marry chargeable services to the free products.[23]

THE EDUCATION ANALOGY

Open content. Unlike software, educational content does not generally come in binary form. There is only the "source code," and in the sense of being readable by humans it cannot be other than open. (The growingly important exception to this rule is for educational content that is itself a program, such as an interactive training tool.[24]) So what does it mean to be *open* in the *open educational content* context?

One possible definition is simply that open means findable and usable. A great deal of educational content is open in the sense that an instructor might allow others to employ it, if he or she were asked. But finding the suitable material in the first place, and contacting the person that controls it, is typically prohibitive. Licensing restrictions aside, posting on the Web can make content open in this sense, if there are adequate search capabilities for locating it, and the materials are in a standard format that allows easy transfer. Many organizations are now working on standards for content to this end.

Before moving on to licensing, it is worth noting that the definition of *content* is not clear either. Consider MIT's OpenCourseWare (OCW) project, one of the most visible open content efforts. It aims to post the "course materials" for every offering in the MIT catalog – some 2000 courses – on public web sites over the next 10 years.[25] Course

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high price – or gives away (almost) the printer and sells the ink cartridges for a high price – it is doing the same thing.

[23] Perhaps this is why some of the most successful open source software is for the kinds of products known to specialized users like web server administrators, rather than end user products like word processors and spreadsheets. But see the open source rival to the Microsoft Office suite at http://www.openoffice.org/.

[24] See, for example, the statistics applets from the companion web site for David S. Moore's Statistics: Concepts and Controversies *W.H. Freeman* at http://www.whfreeman.com/scc/con_index.htm?99spt

[25] See http://web.mit.edu/ocw/. See also Phillip D. Long, "OpenCourseWare: Simple Ideas, Profound Implications" *Syllabus* (January 2002) at http://www.syllabus.com/syllabusmagazine/article.asp?id=5913

materials here can mean anything: syllabi, lecture notes, lectures recordings, readings, paper topics, or quiz questions. The narrowness or expansiveness of the offering is conditioned by copyrights on underlying materials, and, critically, by the preferences of the course instructor.

Is, for example, a syllabus a kind of open content? Or would only posting of the actual materials listed in that syllabus – readings, lectures, etc. – count as open? For some purists, open content must be the materials themselves; and for others, it must be content packaged and indexed according to an accepted standard. For the more pragmatic, any type of open publication is deserving of the open content label, given that any movement toward open-ness is better than none. (For a discussion of the technical considerations in defining and structuring content, see Appendix C.)

Open content licenses. Open educational content can be in the public domain, free of any copyright protection and available without restriction to any user. More commonly, such material comes with attenuated, copyleft-esque intellectual property protections – that may include requirements for proper attribution, limit some or all commercial uses, or enjoin downstream users from adding their own copyright restrictions on the content.

That is MIT's practice, for example.[26] In keeping with its policy for textbooks, MIT faculty retain a copyright to their work, but for OCW it is one that allows unlimited publication and non-commercial re-use by others. (MIT has ownership only if significant institutional resources were used in the production of the material. If a student's work is posted as part of the course content, the student retains the copyright.) The attribution of source requirement means that these copyright holders will earn credit for the work, but absent a later license to a commercial interest there can be no monetary earnings.

A few model licenses for open content exist – such as the Open Publication License (OPL)[27] – but far fewer than in the world of software. It is simply too early to have many examples. As in the open source world, issues of commercial blending constitute the major point of departure in the various approaches that do exist. Unsurprisingly, given that credit for work is critical to promotion and tenure in other academic contexts, licenses for open publications tend to be firm about retention of source credit in derivative versions.

While colleges and universities have traditionally held the rights to commercial products or patents developed by their faculties, they have rarely asserted a claim over copyrights for course materials. The emergence of that exception to the "work for hire" rules of intellectual property was a product of practicality. There was rarely much money to be had from pedagogical output like textbooks, and after a brief flirtation with the prospects

[26] See http://web.mit.edu/ocw/ocwfactsheet.html

[27] See http://opencontent.org/openpub/

for Internet e-learning riches, that is again the perception.[28] Since in the vast majority of cases neither university nor instructor stands likely to gain substantial revenues from content, an open license has little opportunity cost.

Open content communities. A common complaint about current higher education pedagogy is that it remains a "cottage industry" – that is, too many instructors working alone, developing course plans and instructional material from scratch. A community approach to development of content would be one counter to that problem (if it is a problem). As with software development, the communications capabilities offered by the Web dramatically reduce the transactions costs of content collaboration now.

Given that issues of community size and hierarchical rigidity are still open ones in the open source world, it can be no surprise that they are quite unsettled for contributors to open content as well. Is the natural aggregation for such efforts an entire university, as in the MIT OCW project? Is it more appropriate for communities to emerge along disciplinary (or sub-disciplinary) lines, given that productive participation may require an intimate knowledge of a particular subject area? What is the right mixture of democracy and autocracy? All are questions waiting to be answered.

Far more people use open source software than participate in its design and construction. The same is true of educational content generally – only a small fraction of professors write textbooks, for example – and that presumably would be the case with open content. For most instructors, the task of course construction is to blend large amounts of pre-existing (often commercial) content with a few original bits of one's own. This has been a blending of paper products up to now, but digital content collections are emerging to provide clearinghouses for materials – some of them public, some commercial.[29]

Professors' small "original" bits might find their way into such content collections too. Indeed, following on a model of software development, the theoretical ideal is to modularize all educational content into small chunks. Courses can then be assembled from these *content objects* [30] taken from all over. Such an organizing approach can lower the barriers to entry for contributions, and potentially produces a much larger contributing community. It makes it potentially useful to create content on a narrow subject rather than, say, for an entire textbook, just as one can work to improve a small functional part of a piece of software rather than an entire computer application.

Open vs. free content. As with software, to declare content open is not necessarily to make it free. For example, a shareware-esque model could exist, where instructors that

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[28] See the discussion in Carol A. Twigg, "Who Owns Online Courses and Course Materials? Intellectual Property Policies for a New Learning Environment" *Pew Learning and Technology Program* (February 2000) at http://www.center.rpi.edu/PewSym/mono2.html

[29] See appendix E of this report.

[30] The terminology and technology associated with content object construction and delivery is discussed in Appendix C of this report.

adopted a unit of content would be asked to pay a small "contribution" to the author(s). In return for that payment, instructors would perhaps receive additional materials that complemented the open content. (Individual users, engaged in self-directed learning, might be immune from any charges.) Fees for commercial users could also be set, in the name of supporting the non-commercial ones.

Following again on the open source software model, it would also be possible to charge fees for bundled services, such as human technical support of various kinds. One can take the view that no amount of course content (course material) ever adds up to a course, unless there is a human instructor in the mix. If the content is being adopted at another institution, the human instructor might be provided there. (And in that case there might be a shareware license fee.) Alternatively, institution-less students might "buy" the instructor time as a complement to the free materials.

Does the free-as-in-speech rather than free-as-in-beer differentiation work for content too? For software, that translated principally to freedom from unreliability, because of the freedom to inspect and tinker with the underlying algorithms. For content, the equivalent would presumably be (greater) freedom from inaccuracies, because of exposure to a large, improvement-oriented community. To the extent that open content communities are better at this kind of quality improvement than commercial publishers, the analogy holds.

Since switching curriculum is rarely as traumatic as switching software, it is harder to make the case for the importance of freedom from dependence on a particular publisher.[31] Then again, while competition may be feverish for the kinds of materials that serve common high-enrollment courses (such as introductory social and natural sciences), those who teach in more obscure areas may have few choices. Expanded alternatives from open content collections may be particularly welcome.

Open content economics. As with software, we are faced with the question of why content specialists are (or might be) willing to contribute to such collective efforts. First answer: It is a very small fraction of academics that are able to produce pedagogical materials that earn significant revenues. While lots of instructional texts and related products are produced, very few generate for their authors (or their publishers) a large profit. So most academic authors face little or no opportunity cost in making their contributions open rather than proprietary.

But why spend any time on pedagogical creation at all, beyond that necessary for one's own course offerings? We are returned to the explanatory power of a gift culture, where prestige is the coin of the realm. Such an explanation has perhaps less power for open content, however, given the emphasis within most higher education institutions on

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[31] Educational institutions may, like any other organization, be dependent on particular software for its business operations. The increasing dependence on software for educational applications – notably, course management systems (CMS) – may make open source software a particularly important prospect for educational institutions. See the discussion of the Open Knowledge Initiative (OKI) in Appendix C.

research output. Reputation effects, not to mention the concrete rewards of promotion and tenure, flow from more time spent on research, not teaching.

Under what circumstances could we expect this institutional reward structure to change? It can come only when institutions see a greater connection to economic rewards from publication of open educational content. The Web makes low cost publication for a global audience possible as never before. Institutions must believe that reaching that audience is likely to lead to enhanced revenue. For example, they must come to believe that increased applications for enrollment flow to places where the teaching approaches are open for inspection – and appear, from that inspection, to be of high quality. One assumes this is the calculation that MIT has made for its OCW effort, for example.

This is, in effect, another version of the bundling strategy. Opening up content, like opening up source, aims to expand sales of non-open products and services – in this example, the un-open-able experience of physically attending classes at an institution. Such openness is not the norm now – projects like MIT's OCW are on the leading (or perhaps bleeding) edge. Yet it is possible eventually that openness about teaching methods might come to be the standard of behavior, and any institution that failed to open up pedagogy for inspection would be viewed with suspicion.

Indeed, this may already be occurring at the micro level within many colleges and universities. It has long been the norm to have a paper document that opens for inspection a class's major features (topics covered, assignments, grading policy, etc.). To not have a syllabus borders on academic malpractice. It is becoming the norm to post that syllabus and other course materials on the web, so students who are shopping for courses can make comparisons from the nearest computer. Someday, failure to post one's course syllabi on the web may be considered malpractice too. Not just for professors, but for institutions as a whole.

CONCLUSION

Like most socially transforming inventions, the Internet spawns extremes of praise and criticism. In the eyes of optimists, the Web can be "the greatest tool for the equalization of information since the printing press."[32] Pessimists characterize the same abundance as "at its ugliest, just an open sewer, an electronic conduit for untreated, unfiltered information."[33] Both may be correct, depending on what corner of the Internet attracts one's attention. For this report, the question is how to improve and make more generally useful for education the parts that equalize access in positive ways.

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[32] Patrick T. Mulry is just one of thousands of formal and informal commentators on the subject of "the Internet is the greatest…." that can be found with a standard search engine. Full text of Mulry's remarks are available at http://www.courtstuff.com/JCIT/_feefree/00000032.htm

[33] Thomas M. Friedman "Global Village Idiocy" *New York Times* (12 May 2002). Full article text at http://www.nytimes.com/2002/05/12/opinion/12FRIE.html

Television was supposed to revolutionize education too, as were the technologies that preceded it. Thomas Edison looked at the invention of motion pictures and opined in 1913 that there was "no doubt" that the current school system would be completely changed in the next ten years.[34] Yet movies, television and the Web so far remain far more successful at the delivery of infotainment. The most common application by far is electronic mail (and its cousins, chat and instant-messaging), making the Internet into a sophisticated substitute for the telephone network.

What will it take to spur the development of parts of the Web into the 21st century's public libraries? One major impediment up to now has been the lack of standardization for the software components of digital content repositories. Now standards are emerging, and are increasingly integrated into content management tools. While some may wish the pace a faster one, this technical impediment looms less large with each passing year.

Still, even with an architectural specification in place, and technological improvements rendering ever cheaper the necessary hardware and software, content repositories cannot be operated at a zero cost. Tomorrow's digital libraries must be sustained by public- and private-sector contributions to remain free, or move to a regime of user access fees. If free access is a priority, there will remain a need for Internet-era Carnegies.

As bits have replaced ink on paper, the cost of physical resources for publication and distribution is a less important constraint. When it becomes possible for anyone to have access to everything, licensing and connection speed permitting, information abundance may still be as frustrating as scarcity. Even with the emergence of a sufficient number of digital repository facilities – indeed, perhaps *because* of it – finding what one needs will be a formidable task. Indexing will be as critical as it was in the age of physical books. Quality assessment in this new world will be more critical than ever.

Institutions of higher education can contribute not just content, but the quality-signaling information inherent in their "brands." Such branding is already employed for distance education efforts, with most institutions using their reputations for conventional learning as a marketing tool. Reputation can attach to chunks of content too, and may be one of the most important ways that content libraries' users sort though the offerings.

Source branding cannot be the only assessment tool offered to a library's patrons, since the quality of offerings will usually vary substantially across an institution's "product line." Spurring the emergence of trusted third parties to evaluate content may be another critical role for public and private support. (Such entities might do their own rating, or simply provide mechanisms for aggregating and displaying other metrics, such as user evaluations or adoption counts.) Whether such entities should be separate from the libraries, or part of them, is another unresolved issue.

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[34] Reid Cushman, "From a Distance: Who Needs a Campus When You Have a Downlink?" *Lingua Franca* (November 1996) at http://www.uic.edu/depts/engl/projects/tictoc/news/lingfran.htm

Recognition of exemplary open content efforts could be another way of priming the prestige pump, to hasten the change in institutional incentives for open content production. There is as yet no open content-equivalent to publication of a research article in a discipline's most prestigious journals, or the recognition that comes with a disciplinary association's top award. Until there is, authors of exemplary open content will be hard pressed to demonstrate the necessary recognition of their work that convinces institutions to render rewards like promotion and tenure.

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APPENDIX A – DISTANCE LEARNING "CAMPUS" SAMPLER

Alliance for Lifelong Learning http://www.allianceforlifelonglearning.org/	Joint distance learning venture by Stanford, Oxford and Yale universities.
Arizona Regents University http://azdistancelearning.org/	Links to distance courses from the three Arizona state universities.
California Virtual Campus http://www.cvc.edu/	Links to distance courses and programs offered by more than 100 state colleges.
Capella University http://www.capella.edu/	Large distance provider with university degree programs and corporate education.
Cardean University http://www.cardean.edu/	UNext's "learning community" offering business courses and MBA degree.
eArmyU.com http://www.earmyu.com/	Portal for distance courses and programs from 23 colleges and universities, serving soldiers at US Army bases.
eCornell http://www.ecornell.com/	Executive and professional distance education programs from Cornell.
eLearners.com http://www.elearners.com/	Database of distance courses and providers. (fee-based listings).
Excelsior College http://www.regents.edu/	Formerly Regents College. Considered one of the more innovative distance education providers.
Fathom http://www.fathom.com/	Joint venture by University of Chicago, London School of Economics, Columbia University and other partners.
Georgia GLOBE http://www.georgiaglobe.org/	Clearinghouse for distance courses and programs from 34 Georgia colleges and universities.
Global Education Network http://www.gen.com/	Provider of on-line liberal arts courses (just underway).
Global Network Academy http://www.gnacademy.org/	Database of distance courses and providers (free and fee-based listings).

Jones International University http://jiu-web-a.jonesinternational.edu/	One of the first entirely virtual universities to be accredited.
Kentucky Virtual University http://www.kcvu.org/	Clearinghouse for distance courses and programs from 11 Kentucky institutions.
Open University http://www.open.ac.uk/	UK-based, one of the oldest and largest distance education providers.
Penn State World Campus http://www.worldcampus.psu.edu/	Distance courses from Penn State.
Rio Salado College http://www.rio.maricopa.edu/	Considered one of the more innovative distance learning providers.
Southern Regional Education Board Electronic Campus http://www.electroniccampus.org/	Database of distance courses from colleges and universities in 16 southern states.
UK eUniversities Worldwide http://www.ukeuniversitiesworldwide.com/	UK-based, collaborative public-private partnership to promote distance learning.
Univeritas 21 http://www.universitas.edu.au/	UK-based partnership of 18 universities (including the US) to offer distance courses.
University of Illinois Online http://www.online.uillinois.edu/	Clearinghouse for distance courses and programs from the three Illinois campuses.
University of Maryland University College http://www.umuc.edu/	Support center for distance learning courses and programs from the University of Maryland System's 11 campuses.
University of Phoenix Online http://www.online-learning-info.com/	One of the largest distance providers, and among the most financially successful.
University of Texas TeleCampus http://www.telecampus.utsystem.edu/	Support center for distance learning from the UT System's 15 campuses.
Western Governors University http://www.wgu.edu/	Clearinghouse for distance courses from universities and corporations. Degrees and certificates based on "competencies."

Virtual vs. non-virtual institutions. One of the more visible trends in distance learning over the last few years has been the mediocre financial performance of full-blown "virtual universities," particularly those developed by traditional universities as profit-making spin-offs. Some have already collapsed; many are reorganizing.[35]

The now-conventional wisdom is that universities should keep their on-line ventures more tightly integrated with the rest of their offerings. Such a link to a recognized "nameplate" reinforces the perceived quality of the on-line offerings themselves, as well as the value of any degree that may result from taking them.

That wisdom is reflected in the large share of traditional institutions that now offer courses, certificates and degrees via distance education programs – woven into their existing departmental structures, as well as provided by their long-standing "continuing education" programs.[36] It is rapidly becoming easier to list the traditional institutions that *don't* offer distance programs, as guides like the one produced by US News & World Report make clear.[37]

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[35] New York University's NYUOnline, the University of Maryland's University Campus online division, and Temple University's Virtual Temple are among the recent fatalities. See Scott Carlson and Dan Carnevale, "Debating the Demise of NYU Online" *Chronicle of Higher Education* (14 December 2001) at http://chronicle.com/free/v48/i16/16a03101.htm; and Katie Haffner, "Lessons Learned at Dot-Com U." *New York Times* (2 May 2002) at http://www.nytimes.com/2002/05/02/technology/circuits/02DIST.html

[36] USNWR's most recent survey of more than 2000 traditional institutions now finds more than 1000 with online offerings. See http://www.usnews.com/usnews/edu/elearning/elhome.htm

[37] See the University Continuing Education Association listings of traditional institutions providing continuing education and distance education programs at http://www.nucea.edu/conted02.htm and http://www.nucea.edu/Distance02.htm, respectively. See also the listings for part-time degree programs offered by such institutions.

APPENDIX B – DISTANCE AND E-LEARNING METHODS

Not so new approaches. In its broadest definitions, "distance education"[38] encompasses any method of pedagogy where students and teachers need not be in the same place at the same time. The electronic educational tools provided by cheap, powerful computers and communications networks might lead one to consider distance education an essentially modern development. But *e-learning* is just the latest step in a long history.

Consider as a benchmark the oldest form of instruction: tutorials conducted one-to-one, or at least one-to-few. The "invention" of one-to-many lectures yielded some scale economies that are still, for good and ill, in evidence today. But it was the evolution of the written word, and of printing technologies allowing ever-cheaper dissemination of words, that yielded the distance education technology known as books.[39]

"Correspondence courses" conducted via the postal system are perhaps more recognizable as distance education; these were well established by the 19th century, and have continued to the present day. Broadcast radio was the first e-learning educational medium, beginning in the 1920s; it was soon followed by television, commencing in the 1930s, though not really in widespread use for education until the 1960s.[40]

These methods are *asynchronous* – that is, any two-way interactions between teacher and student do not take place simultaneously. For a correspondence course, return mail was the only option, with a lag both obvious and obviously long. Early radio- and TV-based courses were initially dependent on the post too for any real contact with the instructor, but soon came to use telephone links to allow some *synchronous* exchanges. The goal was to restore at least some of the immediacy, if not intimacy, of face-to-face contact.

Blending tools together. Computers and communications networks expand the options dramatically. "Education content" can:

- remain predominantly textual, or contain graphics, animations, simulations, and audio/video multimedia elements;
- unfold along a static, predetermined path or respond dynamically to user choices and performance (so called *adaptive navigation*);

[38] The terms "distance education" and "distance learning" are used interchangeably in this report.

[39] Gutenberg is typically given credit for "inventing printing," for his development of moveable metal type in the mid 15th century, even though other methods of printing (such as time-consuming wood engraving) had been around for centuries. Though Gutenberg's method represented a leap forward (a substantial fall in the costs of printing), it was not until the 19th century that further improvements in printing technologies, paper-production and transportation allowed books (and by extension textbooks) to become mass-market commodities. For a history of these developments, see Pierre de la Mare, "An Industry Born" (21 April 1997) at http://www.dotprint.com/fgen/history1.htm

[40] For a distance education timeline since the 1800s, see Public Broadcasting System, "Distance Learning: an overview" at http://www.pbs.org/als/dlweek/

- be presented primarily *off-line*, with the computer using internally stored materials, or *on-line* (such as via an Internet browser);

- offer only asynchronous interactions with instructors and other students (e.g., via email), or

- if fully and robustly on-line, add real-time exchange using chat rooms, shared screens, whiteboards, and audio/video conferencing environments.

Books have coexisted with tutorials and lectures for centuries. Indeed, we consider this to be a quite natural pairing. Similarly, most distance education efforts today employ electronic tools as complements to rather than complete substitutes for older tools. Paper reading materials and on-line content are intermixed. Face-to-face sessions supplement purely on-line contact, as geography and time permit. And so on.

Such mixing and matching is sometimes called *blended learning* or *hybrid teaching*. Even the most advanced distance learning providers, such as the UK's Open University, still use blended approaches.[41] This is not because of the cost of an everything-on-line structure (though cost is, of course, always a factor); rather, blending remains because of student preferences and, to the extent we can measure it, pedagogical effectiveness.

Blurring institutional distinctions. It is now a commonplace that there has been *convergence* between the methods used to teach distance education students and a traditional resident population. Course web sites, email, bulletin boards, web-streamed lectures and other digital accessories are now common features of "regular" courses at most colleges and universities. Some bricks-and-mortar institutions even offer (and a few require) fully online courses for "regular" students.[42]

In this sense, electronic distance education is now ubiquitous. The "supply" of distance education materials, and the technologies to deliver them, potentially affects the entire population of students, not just a specialized subset. Every bricks-and-mortar institution is, at least a bit, virtual.

Given how little is known about the comparative effectiveness of these tools, the amount of spending implied by such rapid technology diffusion gives some conservative analysts pause. For most, however, the worry is how slow the diffusion has been, and that ancient tools like textbooks are still so common.

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[41] John Daniel, "Lessons from the Open University: Low-Tech Learning Often Works Best" *Chronicle of Higher Education* (7 September 2001) at http://chronicle.com/free/v48/i02/02b02401.htm

[42] The commonly-cited motivations include saving money, conserving scare classroom space, and meeting students' demands for more flexibility. See. e.g, Jeffrey R. Young, "'Hybrid Teaching' Seeks to End the Divide Between Traditional and Online Instruction" *Chronicle of Higher Education* (22 March 2002) at http://chronicle.com/free/v48/i28/28a03301.htm

APPENDIX C – E-LEARNING TECHNOLOGY AND TERMINOLOGY

Content, Platforms and Learners. In the most abstract terminology, the objective is to convey *content* to *learners* (a.k.a., students). Content embraces all the educational material that has, for e-learning applications, been translated into some digital format. *Platforms*[43] include the computers and communications hardware, and the software that runs it, used for the creation, storage, cataloging, assembly and delivery of those materials to learners, as well as the tools to assess what learners have learned.

It is necessary to know from the beginning that digital educational materials are also referred to as *learning objects*.[44] Just as a "book" within a library may be a pamphlet or a multi-volume encyclopedia, learning objects may be simple or complex:

- an individual text file, image, animation, simulation, audio or video clip, applet or anything else under the digitizable sun;
- some combination of these on a particular topic, or aiming at a particular learning objective, perhaps including a testing component; or
- the complete materials for an on-line course.

Typically an object is much smaller than an entire course. Rather it is "chunks" of content -- created, stored, and assembled into a meaningful sequence – that comprise a course. Assessment instruments, such as quiz question sets, can be considered just another kind of object; or assessments can bundled in as part of an object.

While there are evolving technical specifications for objects, there is no fixed standard for their *granularity*, and the optimal approach is still a matter for dispute. One can stay on safe ground by defining objects broadly: as any digital resource that can be (re)used, alone or in combination with other objects, to support learning. (Granularity and combination are the e-learning equivalents of the scope and sequence issues that face instructional design for any medium.[45])

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[43] Sometimes also referred to as the *computing and communications infrastructure*, or the *applications infrastructure*.

[44] Also called content objects, structured content objects, training units, modules, chunks, nuggets, etc., depending on the level of informality. The term "object" derives in part from "object-oriented programming," a successor to earlier notions of "structured programming." Inherent in each conceptualization is breaking down a larger task into simple constituent units, but object-oriented programming is much more than modularization. See David S. Linthicum and Larry Klein, "Structured Programming vs. Object Oriented Programming" at http://userpages.aug.com/frodo/oopstruc.html and Terry Montlick, "What is Object-Oriented Software? An Introduction" at http://catalog.com/softinfo/objects.html

[45] See David Wiley, A. Gibbons and M. Recker, "A reformulation of the issue of learning object granularity and its implications for the design of learning objects" (2000) at http://works.opencontent.org/docs/granularity.pdf

Tags, repositories and referatories. Just as books must be cataloged according to an accepted typology in order to be found, there are specifications for indexing of objects too. Digital content is described by a system of *metadata tags*. Using the library analogy, if content objects are the books, metadata tags are used to make up the card catalog. Tagging taxonomies like the Dublin Core and the IEEE LTSC LOM are the equivalents of the Dewey Decimal System and the Library of Congress Classification.[46]

In the best of all possible worlds, learning objects are envisioned as a pedagogical version of LEGO[47], to use another commonly drawn analogy. Educational search engines would be able to mine a global network of *object repositories* – the contents of which would be comprehensively tagged for easy location, capable of running on any platform (hence, *platform-independent content*) and thus fully reusable without modification (hence, *reusable learning objects* or *RLOs*).[48]

One of the virtues of a (well-ordered) digital world is that communications links can render the details of storage irrelevant, including the location of objects. Searchable "collections" of digital materials might well be nothing more than pointers to materials stored entirely elsewhere – a library that is *only* the card catalog, sometimes called a *referatory* in the new terminology.

Platform typologies. As with content, platforms can be abstractly categorized too, principally as to whether their primary functional focus is on interactions with content or with learners.[49] On the *content management* side:

- *content repository* (a.k.a., *object repository*) *tools* are used to managed the libraries of learning objects;

- *content authoring*, *packaging*, and *assembly tools* allow individuals (or collaborating groups) to create the objects that populate such repositories, and to structure the objects into courses or parts of courses;

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[46] The latter is the Institute of Electrical and Electronic Engineers Learning Technology Standards Committee Learning Object Metadata standard. Thomas D. Wason, "Dr. Tom's Meta-Data Guide" at http://www.imsproject.org/drtommeta.html provides a particularly good introduction to the topic, along with hyperlink references to metadata standards.

[47] http://www.lego.com/

[48] For a more extensive discussion of content object model theories and production guidelines, see Chuck Barrett and Deborah Lewis, "Reusable Learning Object Strategy" White Paper *Cisco Systems* (April 2000) at http://www.cisco.com/warp/public/10/wwtraining/elearning/implement/rlo_strategy_v3-1.pdf

[49] For more on platform functionality typologies and products, see Geoff Collier, "e-Learning Applications Infrastructure" White Paper *Sun Microsystems* (January 2002) at http://www.sun.com/products-n-solutions/edu/elearning/eLearning_Application_Infrastructure_wp.pdf

- *content cataloging tools* and *content search engines* allow presentation of the menu of available objects in repositories, as well as itemize courses assembled out of objects – in effect, digital card catalog creators and browsers.

Learner management functions include:

- *learner access control tools*, to restrict students to a particular menu of courses and resources (e.g., based on tuition payment data, or pre-requisites);

- *learner profiling tools*, to maintain information on student characteristics and progress within/among courses (e.g., degrees and certifications, relevant course completions, any disabilities requiring special presentations, etc.);

- *assessment engines* to handle testing of learner knowledge (if assessment has been separated from object management);

- a *delivery environment* that handles run-time interactions between learners and content – the visible "front-end" of the system from the learner's perspective; and

- *asynchronous* and *synchronous collaboration tools*, such as email, bulletin boards, streaming of audio-video recordings, chat, screen-sharing, and live audio-video conferencing, to augment the delivery environment.

Unfortunately, products available in the real world do not always break down naturally into these categories. Vendors tend to mix and match functionality, in order to exploit perceived market niches. Moreover, terms which purport to describe the functional bundle of any given product are not always applied consistently.

Course/learning management systems. At the learner's end, *web-based training* (WBT) requires only a personal computer with enough power to run standard browser software and connect to an Internet service provider. More ambitious multimedia materials require a fast connection, so delivery by CD-ROM remains an off-line option where high-speed links cannot be assumed. (In the latter case, the approach carries a more generic label: *computer-based training* (CBT).)

Since the late 1990s, most higher education students have become familiar with WBT delivered using *course management systems* (CMS) software. In addition to allowing course web-page generation by relative novices (such as professors), CMS platforms provide capabilities for putting common course tasks on-line – e.g., enrollment lists, quiz administration and scoring, on-line grade-books, and the like. Most also support asynchronous and synchronous collaboration tools like email and chat.

A 2001 survey by the Campus Computing Project reported that more than one in five (20.6 percent) college courses used CMS platforms, up from 14.7 percent in 2000. Most institutions were tied to one vendor: nearly three-fourths (73.2 percent) of survey respondents had a committed to a single product, up from 57.8 percent in 2000.[50] Although there are literally hundreds of such products in existence, the market is dominated by a handful: viz., Blackboard, eCollege, and WebCT.[51]

For the present, CMS systems confine themselves to the teaching/learning arena. They are designed to interface with the *enterprise applications* that manage administrative functions such as student registration, scheduling, financial and library systems. CMS vendors have shown an interest in expanding into one-stop-for-everything enterprise software. In turn, long-dominant higher education enterprise vendors have shown an interest in expanding into learning applications.

Higher education and K-12 software is designed on a model of course assembly undertaken by one or more responsible instructor(s), using templates that the CMS platform provides. Corporate *learning management systems* (LMS) tend to rely less on an instructor-centric paradigm, but essentially provide some of the same functionality bundles. (And, it should be noted, many people use the terms CMS and LMS interchangeably.) Dominant vendors in the corporate sector include Click2learn, Docent, Saba and THINQ.[52]

Emerging standards. Sharing of digital materials across diverse platforms requires common data formats and communications protocols. Up until now, content and learner management functions have primarily been the province of institutions' homegrown systems and commercial products, all using idiosyncratic approaches. E-learning is effectively where the railroads were before the adoption of a uniform gauge for track. But that is changing due to national and international standards development efforts.

Yet again, a bit of terminology is necessary to distinguish the steps in this process.[53] It begins with initial *specifications*, based on a synthesis of anticipated user needs and technical capabilities. *Validation* of specifications comes as developers attempt to incorporate them into actual implementations. Specifications that have proved out in the validation process are submitted to standard-setting bodies, which refine them and consolidate any rival approaches. Only with the last step comes true *standardization*.

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[50] See the 2001 Campus Computing Survey summary at http://www.campuscomputing.net/ Campus Computing Project surveys for the last five years report that, across all sectors of higher education, "assisting faculty [to] integrate technology into instruction" was "the single most important information technology issue confronting their campuses 'over the next two or three years.'"

[51] See http://www.blackboard.com/, http://www.ecollege.com/, and http://www.webct.com/ respectively.

[52] See http://home.click2learn.com/ http://www.docent.com/ http://www.saba.com/ http://www.thinq.com/ etc.

[53] For more on standards and the standard-setting process, see Geoff Collier and Robby Robson, "e-Learning Interoperability Standards" White Paper *Sun Microsystems* (January 2002) at http://www.sun.com/products-n-solutions/edu/elearning/eLearning_Interoperability_Standards_wp.pdf

Such vocabulary precision may seem excessive, but it helps to sort out what is typically a long process, involving collaboration as well as competition among many different organizations. It is easy to become overwhelmed in references to the alphabet soup of entities and yardsticks, especially when true standards are confused with in-process specifications. Among the prominent players in the US today:

- Advanced Distributed Learning Initiative (ADL)[54] is a White House/Department of Defense validation effort, the most famous output of which is the SCORM (Structured Content Object Reference Model).

- Aviation Industry Computer-Based Training Committee (AICC)[55] was formed to develop specifications for training products for the aviation industry, but its work is widely used in other efforts, such as SCORM.

- IEEE Learning Technology Standards Committee (LTSC)[56] is a standard-setting body for the e-learning domain, part of the Institute of Electrical and Electronic Engineers.

- IMS Global Learning Consortium (IMS)[57] is a non-profit industry/academia consortium, begun by EduCause, which has developed a broad suite of e-learning specifications; it has announced plans to undertake product compliance testing.

- Schools Interoperability Framework (SIF),[58] initiated by Microsoft but now under the Software Information Industry Association, is concerned with specifications for instructional and administrative software in K-12 environments.

From these efforts and others, a standard for metadata has emerged, and specifications for content packaging, content sequencing, learner profiling, learner registration, content communication and content registries are evolving. Increasingly, platform vendors market their products as conformant with such specifications and standards (claims often made without any independent verification unfortunately).

While the existence of standards obviously does not guarantee the emergence of a global network of digital educational applications, it is certainly a pre-condition for their success. Funding of elements of the standards development process, and of product testing to assess compliance, is one possible area for expanded government and foundation support to help speed the process.

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[54] http://www.adlnet.org/

[55] http://www.aicc.org/

[56] http://ltsc.ieee.org/

[57] http://www.imsproject.org/

[58] http://www.sifinfo.org/

Open vs. closed platform approaches. Though delivered to the learner via a standard browser, CMS/LMS content is typically stored in the platform vendor's proprietary internal format, and not easily transferred to other systems.[59] Until vendor adoption of content packaging and other specifications allows true interoperability, format lock-in is an important concern. Even with standard content packaging, delivery environment differences may make user retraining non-trivial, so lock-in is still an issue.

The Open Knowledge Initiative (OKI), a project led by MIT and Stanford and involving a coalition of several other US universities, is in part an effort to reduce lock-in. If the standards for data formats and communications protocols discussed earlier are the equivalent of a standard railroad track gauge, OKI is equivalent to specifications for the locomotives and the railcars. Its primary product will be architectural – specifically, designs for application programming interfaces (API) that can be used by educational software like CMSs and LMSs.

OKI's leaders have not always been clear on whether they intend to build functioning models based on these specifications. In some announcements, they have signaled that the project does not intend to compete with commercial CMS/LMS vendors, looking only to commercial firms to design systems that comply with its blueprints. Other, more ambitious renderings of the OKI portray it as the eventual developer of an open source CMS/LMS, freely available to anyone.[60]

Because of the open source approach, it is hoped that a community of developers will emerge to build bits and pieces of CMS/LMS, to be mixed and matched by end users. In this way, educational platform development might come to match the successes of projects like Linux and Apache.[61]

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[59] For example, in April 2002, Blackboard announced the release of its "EasySwitch" utility, designed to allow users to convent materials from WebCT into Blackboard format. Presumably EasySwitch only works in one direction. Press release at http://company.blackboard.com/press/viewrelease.cgi?tid=205

[60] Ibid.

[61] For further discussion of open source, and these projects, see the body of this report.

APPENDIX D – COMMERCIAL E-LEARNING CONTENT

Repurposed content. Commercial textbooks and "readers" remain one of predominant mechanisms for delivery of educational material; and it is still primarily rendered on the material known as paper. However, commercial education publishers have a long history of leveraging new technologies to enhance paper-based materials, and that tradition continues today with *repurposing* of paper content for use on electronic platforms.[62]

In past decades, texts might come bundled with lecture "transparencies" for overhead projectors and printed booklets of sample examination questions, suitable for photocopying. Today they are likely to be accompanied by such add-ons as PowerPoint slides and test batteries, all conveyed on digital media.

Internet-based services are also extensively employed by the largest publishers to enhance paper texts. "Companion" web sites provide supplemental information, practice drills and quizzes, and other study aids for students; such sites may also be the vehicle by which add-on teaching materials like slides are delivered to instructors.[63]

Publishers increasingly offer pre-packaged digital versions of their textbooks too, designed to fit into the popular course management systems,[64] or offer their own CMS equivalent.[65] Independent companies have also arisen to "re-package" textbooks under license in all-digital versions – designed for delivery from a range of on-line platforms, and spiffed-up with search engines, note-taking tools, practice quizzes and supplemental web links.[66]

Not to be outdone, CMS vendors have become course content sources too, aggregating and repackaging materials for their own platforms. Blackboard, for example, markets a

[62] Almost all textbook publishers maintain web sites, even if their offerings are only paper-based. For a list of such sites, see ACQWEB's Directory of Education Publishers and Vendors, especially the sub-directory for textbooks, at http://acqweb.library.vanderbilt.edu/acqweb/pubr/educ.html

[63] See, for example the list of "book companion sites" for texts of Bedford, Freeman and Worth Publishing Group at http://www.bfwpub.com/

[64] For a discussion of course management (CMS) platforms, and other e-learning support software, see Appendix B of this report.

[65] Publishing divisions of McGraw-Hill Higher Education (http://www.mhhe.com/) offer such supplements as "learning objectives, a chapter summary, video, [and] an interactive glossary" in "On-line Learning Center" companion web sites. The textbook content may also be pre-packaged for several different commercial CMS products as well as their own system ("Pageout"). Similarly, several publishing divisions of Thomson Learning (http://www.thomsonlearning.com/) such as Harcourt College Publishers and Holt, Rinehart and Winston (http://www.hrwcollege.com/) package texts for the major commercial CMS platforms. Pearson Education (http://www.pearsoned.com/) divisions such as Addison-Wesley (http://www.awlonline.com/) offered textbooks packaged into their "CourseCompass" system, an adaptation of the popular Blackboard course management system.

[66] See, for example, the offerings at WizeUp.com, Inc. at http://www.wizeup.com/

library of "course cartridges" derived from some 30 different publishing sources, including its own imprint; WebCT offers a collection of "e-packs," from more than 20 different publishers.[67] (One could say these collections are fee-based, platform-specific digital repositories.)

Paper-based readers or "coursepacks" remain popular as supplements to, and occasionally as replacements for, textbooks. Many colleges and universities now offer "service centers" to assist faculty in assembling coursepack materials and obtaining the requisite copyright clearance. Naturally, there has been a migration from paper-only to on-line versions, delivered electronically instead of at a bookstore, made to be read on screen or printed at the student's discretion. Several commercial firms have entered this market as well.[68]

"Custom textbooks" occupy a middle ground in this typology. Functionally, they are generally designed to replace off-the-shelf textbooks; but, like coursepacks, they are assembled from pieces chosen by the instructor.[69]

As with the other types of course content, custom textbooks may be delivered in printed form, conveyed in an off-line (but nonetheless digital) medium like a CD-ROM, or distributed over the web (either via a standard browser interface, or through a CMS). Non-paper distribution obviously opens up the range of information presentation from text and static illustrations to dynamic multimedia applications.[70]

While digital renderings are the area of greatest market growth, older "new media" remain as competitors to paper too. Educational audio- and video-tapes remain a substantial force, albeit one often marketed from, and designed to be complementary with materials on, a web-site.[71]

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[67] See http://cartridges.blackboard.com/catalog/ and http://www.webct.com/content respectively.

[68] See, for example, the popular XanEdu (http://www.xanedu.com/), which claims to be able to assemble coursepacks from an "ever-growing archive of over 5.5 billion articles, cases and other documents from thousands of publishers."

[69] Primis Custom Publishing (http://www.mhhe.com/primis/), a division of McGraw-Hill, is one commercial vendor of custom textbooks. "Authors" may pick and choose from materials in the publisher's collection, submit new content, or generate a combination of both. See also the custom textbook services at The Haworth Press (http://www.haworthpressinc.com/books/custtext.asp) or CDC Solutions / R R Donnelly and Sons (http://www.cdcsolutions.com/RRDonnelleyandSons.asp).

[70] A good example of simple yet dynamic course content is provided by the interactive "applets" from the companion web site for David S. Moore's Statistics: Concepts and Controversies *W.H. Freeman* at http://www.whfreeman.com/scc/con_index.htm?99spt

[71] See, for example, the "Great Courses" audio and video offerings of The Teaching Company at http://www.teachco.com/.

APPENDIX E – OPEN E-LEARNING REPOSITORIES

General collections of open digital content collections are emerging too, but remain comparatively rare. Examples include:

- Connexions[72] – sponsored by Rice University, emphasizing open-source/open-content (free) materials for all education levels;

- Marco Polo[73] – referatory to free K-12 content and teaching resources on affiliated sites, sponsored by MCI WorldCom and a consortium of content providers;

- MERLOT[74] – sponsored by a consortium of universities, with links to and rating of free higher education content; and

- World Lecture Hall[75] – referatory to free course materials from institutions around the world, sponsored by the University of Texas at Austin.

Each maintains a searchable directory, organized by keyword and subject area. Quality ratings are provided, but the ability for an outside user to assess content without actually examining it remains primitive – even compared to the relatively limited assessment systems provided by software download sites,[76] or that of the redoubtable eBay.[77]

For example, users can recommend particular World Lecture Hall offerings for "showcase" status based on perceived merit; but it is not yet possible to search the subset of courses that have received such accolades. MERLOT offers both member comments (anyone can be a member) and "peer review" by groups of two or more higher education faculty (who must compose a "composite review"). At this early stage in its development, very few of its materials have peer reviews; typically there are only a handful of member comments at best.

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[72] Project home page at http://cnx.rice.edu/

[73] Content partners include the American Association for the Advancement of Science, National Council on Economic Education, National Council of Teachers of Mathematics, National Endowment for the Humanities/Council of the Great City Schools, National Geographic Society and The Kennedy Center. See http://marcopolo.worldcom.com/

[74] An acronym for Multimedia Educational Resource for Learning and Online Teaching Project home page at http://www.merlot.org/

[75] http://www.utexas.edu/world/lecture/

[76] See the popular CNET software download site at http://download.com.com/

[77] Though the quality of the assessments can certainly be debated, eBay gets points for comprehensiveness. Every sale/purchase transaction generates a request by the system for the buyer to evaluate the seller and vice-versa. Such ratings are provided a one-click's remove from any listing. See http://www.ebay.com/

Connexions has only a few elements of demonstration content at present, and so offers no concrete clues to its approach to searching generally or quality assessment in particular. The philosophy of the project is one of total openness – anyone may contribute material, anyone may undertake to improve it, and anyone may rate the efforts of others.[78] It remains to be proved that such a democratic approach will be more beneficial than a more closed system.

Marco Polo offers an example of the latter approach, since content is vetted solely by the six affiliated organizations that provide content. Its collection is fairly extensive in those areas. No quality ratings are provided.

[78] See details in http://bunker.ece.rice.edu/users/demo/ConnexionsWhitePaper.pdf