The Research & Learning Landscape

The Research & Learning Landscape

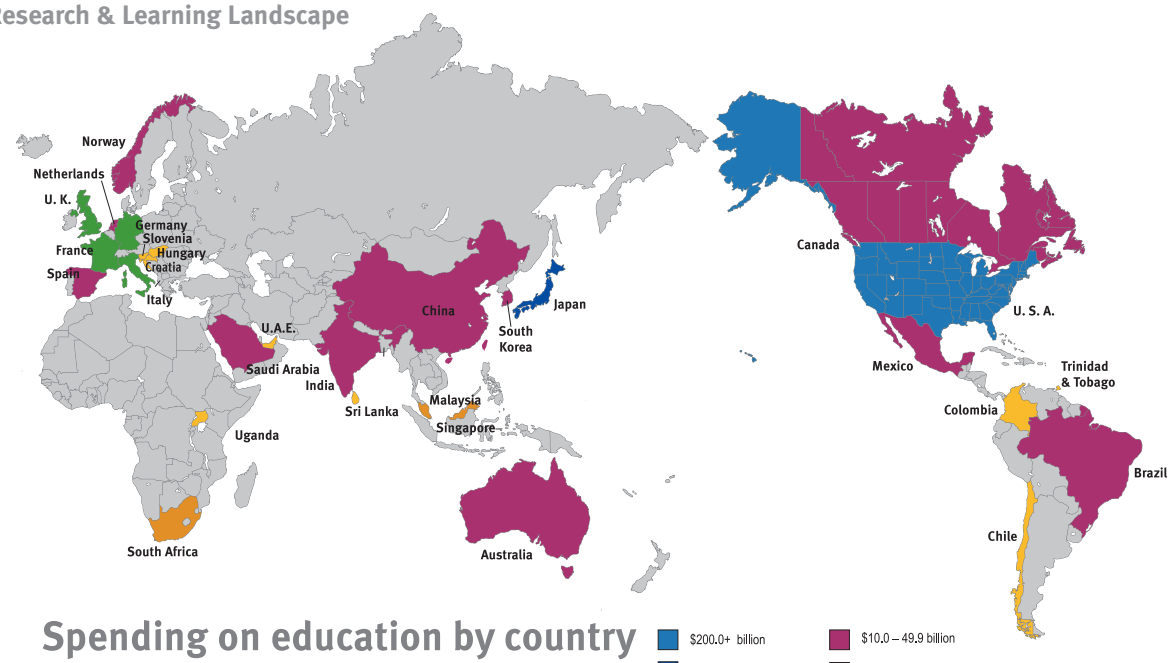
Patterns of change in the research and learning landscape cover not only the institutions engaged in research and learning, but also encompass research and learning practices of individuals. Learning is a process that can take place in designated primary, secondary and tertiary institutions of learning, and it is also a self-directed, personal process, as well as a workplace activity. All these kinds of research and learning activities impact libraries and allied organizations. The aim of this section is to identify the most important trends of the changing research and learning landscape as they may impact these organizations.

Major trends

- **Reduced funding**
- **Proliferation of e-learning**
- **Lifelong learning in the community**
- **The changing pattern of research and learning in higher education**
- **Institutional repositories, scholarly communication and open access**
- **New flows of scholarly materials**

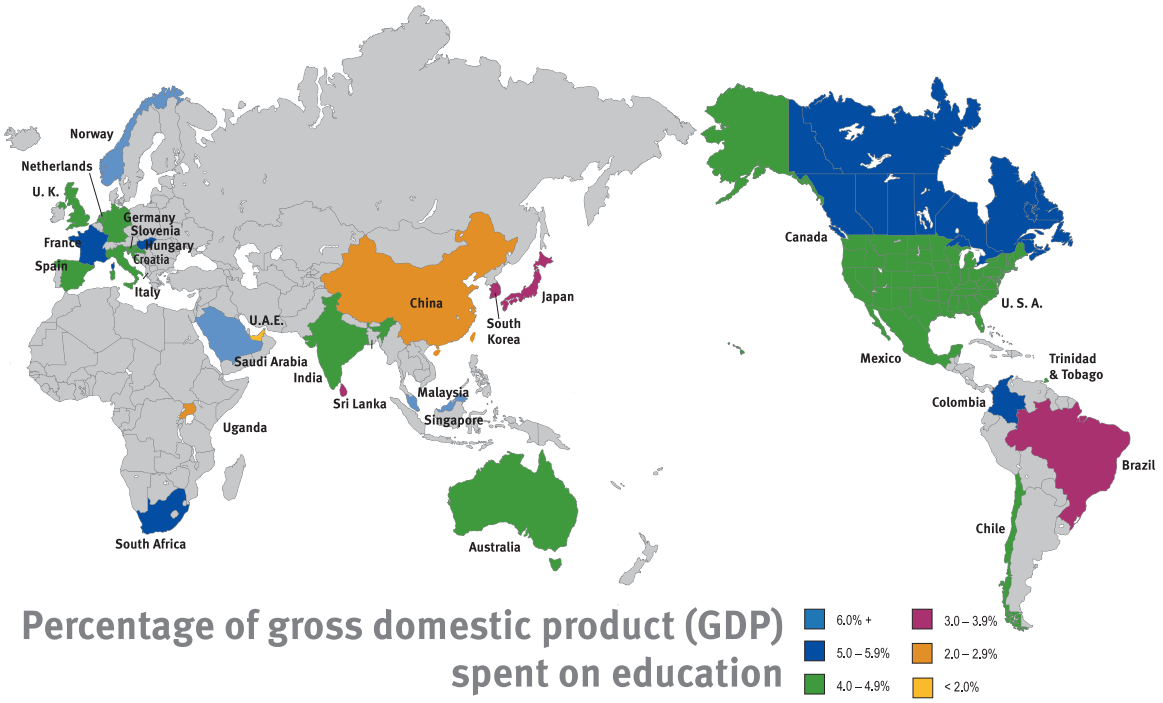
Reduced funding

Consistent with trends we examined in The Economic Landscape, the areas of K–12 and higher education are experiencing reduced funding as governments struggle to constrain expenditures without increasing taxation.



Spending on education by country

$200.0+ billion
$100.0 – 199.9 billion
$50.0 – 99.9 billion
$10.0 – 49.9 billion
$5.0 – 9.9 billion
< $5.0 billion



Percentage of gross domestic product (GDP) spent on education

6.0% +
5.0 – 5.9%
4.0 – 4.9%
3.0 – 3.9%
2.0 – 2.9%
< 2.0%

Country education spending

Country	Education Spending (Billions)	% GDP on Education	Country	Education Spending (Billions)	% GDP on Education	Country	Education Spending (Billions)	% GDP on Education
United States	$ 500	4.8%	India	$ 21	4.1%	Hungary	$ 3	5.0%
Japan	$ 139	3.5%	Netherlands	$ 20	4.8%	Singapore	$ 3	3.7%
Germany	$ 89	4.5%	Australia	$ 19	4.7%	Chile	$ 3	4.2%
France	$ 82	5.8%	South Korea	$ 18	3.8%	U.A.E	$ 1	1.9%
United Kingdom	$ 70	4.5%	Saudi Arabia	$ 18	9.5%	Slovenia	$ 1	4.9%
Italy	$ 54	4.6%	Brazil	$ 17	3.8%	Croatia	$ 1	4.2%
Canada	$ 39	5.4%	Norway	$ 13	6.8%	Sri Lanka	$ 0.5	3.1%
Spain	$ 29	4.5%	South Africa	$ 6	5.7%	Trinidad & Tobago	$ 0.4	4.0%
Mexico	$ 28	4.4%	Malaysia	$ 6	6.2%	Uganda	$ 0.1	2.3%
China	$ 27	2.2%	Colombia	$ 4	5.1%			

Source: UNESCO Institute for Statistics (May 2003).

Library directors are increasingly focused on fund-raising.

Director, Academic Library

In the United States, the situation is unlikely to change any time soon. According to the National Center for Public Policy and Higher Education, all but a handful of states will find it impossible to maintain current levels of public services within their existing tax structures.[1]

These projections suggest that the fiscal prospects for higher education are not rosy. At the same time, there is a strong interest in increasing access for qualified students as the "branding" of the value of higher education is firmly embedded in the social fabric. Calls for accountability and measurability mentioned in the Economic Landscape are loud and clear in the research and learning landscape.

"We can no longer put billions of dollars into the system without expecting colleges to become more affordable. We can never give enough aid if colleges just keep raising their prices. The federal government will continue to do its fair share to help bridge the financial divide between what families can afford to pay for college and what they are expected to pay. We will support those institutions that are trying to make college less expensive. But because the federal government provides 70 percent of all financial aid, it is time for Congress to demand accountability. We must seize this opportunity and ask colleges to do their part in increasing access to higher education."[2]

Viewed solely through a funding lens, the future of education looks pretty dismal. And indeed, if the structure and organization of educational institutions remain as they are today, the future is likely not rosy.

"If we are worried about the declining state of education and decreasing state and federal budgets, disruptive innovation could be a powerful new framework for the debate over how best to improve primary and secondary schools. If the debate is framed around preserving the status quo, then disruptive innovations are of little use. However, if the debate is framed around how to provide the best quality instruction at the lowest possible price to the greatest number of people, officials should find a way to encourage the creation of disruptive business models. Successful disruptive business models will fling open the doors of quality education to previously underserved and nonconsuming populations. Moreover, social and economic welfare will increase as more people learn at all educational levels."[3]

Proliferation of e-learning

E-learning might be one of the disruptive innovations in education. It now has a presence in most large corporations and in an ever-increasing number of college and university courses. In this section we look at general trends in e-learning as a delivery mechanism.

Once synonymous with distance learning, e-learning has quickly evolved to include not only courses that are taught primarily online and over a distance, but also those that include traditional, "building-based" courses that have been enhanced with electronic elements. These "hybrid" courses are offered by 80 percent of U.S. institutions, according to a report from the EDUCAUSE

1. Dennis Jones, "State Shortfalls Projected Through the Decade," *Policy Alert* (February 2003).
2. Howard P. McKeon, "Controlling the Price of College," *The Chronicle of Higher Education* (July 11, 2003): B20. (McKeon is the Chairman of the House Subcommittee on 21st Century Competitiveness and has introduced the College Affordability in Higher Education Act.)
3. Clayton M. Christensen, Sally Aaron and William Clark, "Disruption in Education," In *The Internet and the University Forum 2001* (Boulder, CO: EDUCAUSE, 2002): 41.

Center for Applied Research.[4] However, the number of such courses offered is still only a small percentage of all courses offered.

Not surprisingly, there has been a parallel growth in the number of institutions using course management systems to manage hybrid courses' electronic elements. They have moved swiftly from scattered implementations that support a few online classes to enterprise-wide services that support and extend the entire curriculum and related institutional services. Course management systems such as WebCT and Blackboard allow for the creation of a virtual classroom where faculty and students can interact and post curriculum-related material.

E-learning in the university[5]

Universities have had a difficult time making distance education cost-effective and pedagogically effective because they usually tried to deliver traditional courses via a nontraditional medium. As Christensen points out in "Disruption in Education"[6] the failure of this sort of online learning was that, essentially, it delivered a course to consumers who experienced it as a lesser and unsatisfactory version of a campus-based course. Newer models of nonclassroom-based education do not try to duplicate the classroom environment but instead embrace technology as a way to reach students.

University of Phoenix, The Netherlands—Graduation MBA 2003

More than 170,000 students are currently enrolled at the 134 campuses and learning centers of the University of Phoenix, making it the largest private institution in the United States.

www.universityofphoenix.com

The University of Phoenix was one of the first institutions to use the Internet to deliver course material at a time when other providers were shipping physical books. Founded in 1976, it was one of the first accredited universities to provide college degrees via the Internet to students who would not be able to attend classes on a physical campus, for reasons of time, geography and preference.

Another more recent entrant into the "disruptive online learning" space is Universitas 21 (U21), a consortium of international universities offering postgraduate online courses. The first degree program is an MBA. "It is estimated that the e-learning market in the Asia Pacific region will reach US$400 million by 2005. That's two years from now. Depending on living standards, fees vary across countries. So an Indian pays US$11,000, while a Singaporean US$13,000 [...] Dr. Mukesh Aghi, CEO of Universitas 21 Global, said: 'There are roughly 35 million students who are unable to get that education and that number will grow to 100 million in 10 to 15 years.' The institution said it would not mimic a traditional brick and mortar university and so there won't be any video-conferencing. While doing assignments, students can access articles, journals and periodicals in the online library. But they won't be able to gain access to the libraries of participating universities."[7] Students will, however, be able to access content provided by Thomson Learning, through Thomson's proprietary learning management system.

4. ECAR Respondent Summary: *Evolving Campus Support Models for E-Learning Courses* (March 2003).
5. For a thorough discussion of e-learning in the academic setting at it pertains to libraries, see OCLC E-learning Task Force (Neil MacLean and Heidi Sander, primary editors), *Libraries and the Enhancement of E-Learning,* (Dublin, OH: OCLC, 2003), www5.oclc.org/downloads/community/elearning.pdf.
6. Christensen, et al., "Disruption in Education."
7. Ca-Mie De Souza, "Online university group in S'pore invests $50m to sell courses to Asian students," *ChannelNewsAsia.com* (September 7, 2003).

Centrally stored materials that can be repurposed might be sensible.

Academic Librarian

Creating, managing and delivering content in an e-learning environment requires the conscious and planned collaboration of several sectors of a university's community. Faculty, IT staff, administration staff and librarians all have roles and responsibilities in content management; however, these sectors have generally worked relatively autonomously from one another. Cooperation and collaboration become crucial.

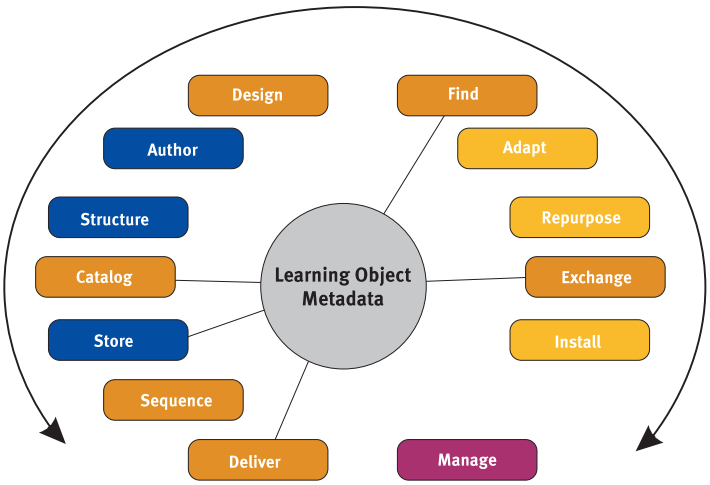
It is not only the organizational elements of a university that must work together to deliver content successfully and effectively to students. Learning materials themselves must, in a sense, collaborate. In the past, if a history professor used the Shakespeare play *Titus Andronicus* to illustrate a particular point about warfare, she did not take the classroom material—the learning object—created by her colleague the English professor on the same play and repurpose it for her needs. In a pedagogical world supported by an enterprise-wide course management system, this becomes possible, and perhaps, desirable. These learning objects need to be managed just as the books in the library do.

Learning objects

Learning objects are the basic electronic building blocks for e-learning. They are sharable, fine-grained materials that can be recombined and reused in different course offerings. In this sense, learning objects are "multicultural." In an ideal world, learning objects can be used over and over, and can be combined with other learning objects to make new ones.

Learning object repositories are emerging at the campus level and in wider settings. For example, CAREO (Campus Alberta Repository of Educational Objects—www.careo.org/) is a project supported by the provincial government education department, Alberta Learning, and CANARIE (Canada's advanced Internet development organization) that has as its primary goal the creation of a searchable, Web-based collection of multidisciplinary teaching materials for educators across the province and beyond.

Learning objects[8]



Learning object life cycle diagram[9]

8. Learning objects courtesy of Dr. Jim Flowers, Department of Industry & Technology, Ball State University.
9. Learning object life cycle picture courtesy of Dan Rehak, Carnegie Mellon University.

E-learning in the workplace

E-learning is also the term used to describe corporate or work-based e-learning. In 2001, estimated worldwide revenues for 2004 for corporate e-learning were just over US$23 billion dollars, up from less than $2 billion at year-end in 1999.[10] Companies purchase e-learning for workers for many of the same reasons that individuals take university courses online: travel time is reduced, infrastructure costs are low, delivery is platform independent and learning anywhere and anytime is enabled.

E-learning is big business. In the September 1, 2003 issue of *Fortune,* the 100 Fastest Growing Companies are profiled. Number 4 and number 6 are e-learning companies: Career Education (revenue: $849.3 million) and Corinthian Colleges ($472.9 million). Both offer postsecondary courses to a combined total of over 100,000 students on more than 150 campuses.

Overall, there's a lot of internal resistance [at the press] to any e-learning initiatives due to status quo thinking.

University Press Editor

Lifelong learning in the community

"We often hear it said that libraries (and librarians) select, organize, retrieve and transmit information or knowledge. That is true. But those are the activities, not the mission, of the library. Certainly we perform those activities, but the important question is: To what purpose? We do not do those things by and of themselves. We do them in order to address an important and continuing need of the society we seek to serve. In short, we do them to support learning. [...] We must create a learning society."[11]

A learning society, lifelong learning, learning for life, the knowledge-based economy: the emergence of learning as an important political agenda has challenged libraries, museums and related organizations to show that they can make a difference, that they add value, that they are central to educational and civic missions. This is a common international theme, played out in different social and political contexts. Interestingly, this theme emerges at the same time as a more general questioning about the value of public goods and the open availability of resources.

Learning is an issue that resonates throughout social and political discussion.

A knowledge economy

A knowledge economy is a general label for an economy in which technology and the knowledge on which it is based are central motors of economic growth. This means that a growing number of workers manipulate symbols rather than machines. And it means that human or intellectual capital—the knowledge that comes from education, training, on-the-job experience and workplace-based e-learning—is central to sustaining personal and organizational advantage.

10. IDC, *Worldwide Corporate eLearning Market Forecast and Analysis,* 1999–2004 (2001). As quoted by Cerint Technology Group, www.cerint.com/company/The_Worldwide_Corporate_eLearning_Market-IDC.pdf and Margaret Driscoll, IBM Mindspan Solution.
11. Robert S. Martin, "Reaching Across Library Boundaries," *In Emerging Visions for Access in the 21st Century Library*, (August 2003): 11.

Library and communities

This economic shift has some implications:

- The ability to learn and to adapt to change is a central life skill. Learning is valued as a crucial coping skill in an environment of change and flexibility.
- There is growing fragmentation between those who are connected and those who are unconnected, where "connection" literally and metaphorically stands for social inclusion, in terms of access to life skills, opportunity and the instruments of learning.

The library can be a resource to other community agencies in information management.

Director, Public Library

- The global network is enabling interest communities to collaborate in real time on a planetary scale. This has been visible with large corporations and financial markets where information flows without recognizing borders. Research communities and other groups benefit from the ability to work together. At the same time, there is a resurgence of interest in regional and local identities as the world is recast as a network of regions and cities, as a sense of community and belonging becomes more important against this globalizing background. There is a growing desire to reclaim the local, to make local history and heritage resources more visible. New forms of community and identity are being forged around affinities of religion, politics, gender and lifestyle, and find support in network frameworks. Blogs and discussion groups are examples.
- The role of public services in the digital environment is under scrutiny. We can see countervailing trends. On one hand there is a general focus on access, on digitizing heritage collections, on making available the results of government-funded research, on providing learning and community resources. An especially interesting issue here is the emergence of home-schooling, and the corresponding lobby to have educational materials available on the network to support progressively advancing learning and teaching needs, particularly in math and sciences. On the other hand, there is a progressive commoditization of knowledge, a desire to restrict access to materials, through licensing and fees.

Libraries in the community

Libraries of all types seek to build the relationships and provide the services that create value to their communities, and which corroborate their role as trusted hubs of community and learning. This involves supporting the variety of learning experiences actively, in working with others to create the visible fabric of community, and in continuing as unobtrusive agents of social cohesion and personal fulfillment.

Libraries need to collaborate to create "whole cloth" collections irrespective of location or holding library.

Public Librarian

Here are some roles libraries play:

- Equalizing access in a fragmented society. Libraries have always supported the development of reading, writing and communication skills as well as the development of learning and information skills.
- Supporting the learning experience. Libraries, museums and related organizations are more consciously providing instruments for self-directed learners and curriculum support materials, and are teaching people to be learners. They recognize their complementarity to the formal learning process.
- Globalization and regionalization. The library is a gateway to global resources as a "gone digital" organization, but at the same time it acquires strong regional and local purpose—whether as part of a university with business, learning and cultural links, as a state or regional library that assumes the role of disclosing the business, historical and cultural identity of its area, or as community venue for reading sessions for dogs, belly dancing and meetings of the local DAR.
- The library, historical society and archive have a role in describing the explicit relationships and objects that are evidence and witness of a community and its sense of itself, or rather of the multiple communities that share any library. Local history records, sport, art, culture, social activities: these can be noted, described and shared. Individually such services provide value; made available as a network resource and brought into the same context of use as other such resources, that value is much enhanced.

The staff has an emerging role in assisting the public in using electronic resources. The principle is that, in the public library, you learn, you are not taught. The librarian's role is to facilitate self-learning, not to act as a teacher.

Public Librarian

Libraries are an important part of the civic fabric, woven into people's working and imaginative lives and into the public identity of communities, cities and nations. They are social assembly places, physical knowledge exchanges, whose use and civic presence acknowledge their social significance and the public value accorded to them. In many countries throughout the world, they form a widely dispersed physical network of hospitable places, open to all. Every library is different, but to enter any one is to come home, to experience a "third place" whose mission is defined by service, where people can work unobserved and can develop as they wish. This trusted community role places libraries in a unique position to support the lifelong learner.

The changing pattern of research and learning in higher education

As part of a university or college, the academic library is not an end in itself. It supports research, learning and scholarship, and it has always had to adapt as research and learning behaviors change. However, in the current network environment, this change is uneven and uncertain and poses great challenges for libraries.

"I assume that university libraries will adapt to change in education and research institutions as they are transformed through the digital revolution."[12] However, as we have seen in our discussion of trends in the social and technology landscapes, learning behaviors of young people—both students and faculty—have changed a great deal, and the institutions supporting their research and learning for the most part have not changed to accommodate the newer members of this community.

"The current generation of scientists is much more familiar with PubMed and Google than the contents of their library shelves."[13]

We can't develop and enforce policies for collecting institutional content beyond our own domain.

Government Librarian

Infrastructure changes

There is a growing investment in learning management systems to mediate and manage the learning experience. Learning materials are being produced in various digital forms and need to be managed. Faculty are creating, analyzing and using digital resources in many ways. Scientific research is being transformed and there is huge investment in large-scale computing infrastructure to support new modes of working. Change may be slower in the humanities and social sciences, but is significant.

In general, the system of scholarly communication is being transformed in unpredictable ways.

Universities are taking a stronger interest in managing their own digital assets, and, in making them more widely available, the library has the opportunity to become involved at various stages, looking at taking on broader institutional asset management responsibilities.

Research is increasingly being carried out in groups, and across historically defined disciplines and also across institutions.

The library is becoming more engaged with the research and learning behaviors of its users, and is supporting them at more stages in their work. Libraries are working in new partnerships with faculty and students and developing new models of academic support.

Libraries, academic computing, administrative computing, educational technology and sometimes the campus bookstore, media services and university press are increasingly being gathered organizationally under one senior university administrator. Where such alignment is not organizationally enacted, libraries and other services are recognizing their overlapping interests and the need for partnership.

12. Robin Stanton, "Towards Supported 'Communities of Interest' in Digital Environments," In: *Emerging Visions for Access in the 21st Century Library* (2003): 33.
13. Susan R. Owens, "Revolution or Evolution?" *EMBO reports* 4, no.8 (2003): 741-3.

"I see a great opportunity for the next five years for a more rigorous and pragmatic partnership between librarians, IT professionals and scholars. While that may sound obvious, it really has not been done."[14]

The key to having the library a player in the institutional repository is to have recognized the trend early, and to "work the room" early.

Director, Academic Library

And finally, there is an emerging emphasis on integration among systems that support learning, research and administration, and a corresponding interest in campus architectures, repository and portal frameworks, and common services such as authentication and authorization.

This technological movement is changing the way faculty and students access, create and use information resources and is creating new support challenges. Among these are questions of how best to support the life cycle management of learning materials; how to develop greater systems integration among learning management, library and administrative systems; and how to diffuse information skills throughout learning activities.

Computing and its supporting infrastructure have evolved steadily and rapidly for 50 years, but the impact on scholarly research methodologies has become particularly evident as these changes have surfaced in ubiquitous personal computing capabilities and high bandwidth connectivity.

Grid computing (http://www.gridcomputing.com) is a strong manifestation of these trends. This community promotes the development and advancement of technologies that provide seamless and scalable access to wide-area distributed resources. Computational grids enable the selection and sharing of geographically distributed computational resources. The idea has become popular in a variety of academic research environments, including computer science, molecular modeling and drug design, biophysics and high-energy physics.

Impact on the sciences

I think it would be beneficial for librarians and publishers to work more closely together to identify consumer needs and content delivery systems.

University Press Editor

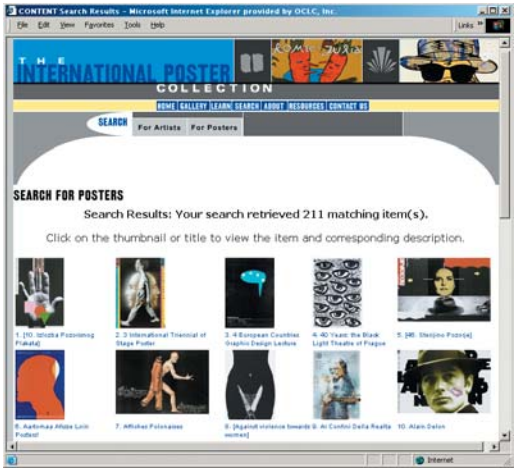
The impact in the sciences has been greater than in the humanities and social sciences. The ambitious recommendations of the NSF Cyberinfrastructure Advisory Panel[15] give an indication of directions science and technology research might go. The report points to the major opportunities for research that emerge from the ubiquitous availability of broadband computing, from the generation of massive amounts of data and from visualization and simulation. It highlights the strong trends in current research towards federation of distributed resources (data, content collections and computing facilities) and distributed, multidisciplinary expertise.

Currently these trends are exemplified in projects and programs involving aerospace research, earth sciences and ecological studies, physics and energy research, biomedical informatics and advanced computing initiatives. The close connection of research and education is particularly critical in this context. Success will depend on providing high-quality educational opportunities necessary to the support of any advanced work. But in addition, the expanded scope and intrinsically distributed, multidisciplinary character of these trends will present particularly novel challenges that must be met with innovative educational technology and management and

14. Chuck Henry, "Redefining the Role of the Library," [interview] *Ubiquity* 4, no.25: n.p.
15. Daniel E. Atkins, et. al., *Revolutionizing Science and Engineering Through Cyberinfrastructure,* Report of the National Science Foundation Blue Ribbon Advisory Panel on Cyberinfrastructure (January 2003).

funding. The report also identifies fundamental risks that imperil such progress, including the loss of poorly-curated data, lack of standardization of data formats and poor coherence among IT research, the IT industry and domain science.

The panel proposes the establishment of the Advanced Cyberinfrastructure Program to be funded at an annual level of US$1 billion to address these opportunities.



Home page of the International Poster Collection, created by the Colorado State University Libraries and the Department of Art.[16]

Impact on the humanities

Research in the humanities is changing as well. Though its scope and character are on a smaller scale than the massive, distributed science research projects, humanities and social science research increasingly rely on the availability of information on the scholars' desktops.

The proliferation, especially in the humanities, of new varieties of scholarly artifacts—software, interactive components and multimedia objects—presents novel impediments to discovery, access and preservation of such materials. Wendy Lougee points to the importance of new collaborations between cultural stewards and scholars as essential to the survival of the objects of their stewardship.[17]

The shift of librarianship from a role of service provider to collaborator will be particularly important if the many new varieties of scholarly output have any hope of being cataloged and therefore disclosed to potential users, and preserved in ways that will sustain their value to future scholars.

Libraries and archives contain many of the primary materials upon which research in the humanities is based. However, access to these materials is often inhibited by limited or absent cataloging or finding aids. This makes the collections available to those who already know about them, or who come across them serendipitously. This in turn limits scholarship or teaching based on those materials. It is clear that there is still a major descriptive challenge ahead for libraries, which will involve looking at descriptive practices and looking at greater investment in collection-level description.

Access to materials

The policies and techniques for capturing, sharing and preserving scholarly assets are as yet undeveloped, but Abby Smith[18] classifies approaches to these problems in two categories:

- Enterprise-based model—essentially, institutions assume responsibility for preserving and managing these artifacts, perhaps in the institutional repository.
- Community-based model—third-party stewardship that emerges from a community or discipline. ARTstor is an example of this model.

16. Colorado State University Libraries, International Poster Collection (2001), http://manta.colostate.edu/posters/.
17. Wendy P. Lougee, *Diffuse Libraries: Emergent Roles for the Research Library in the Digital Age* (Washington, D.C.: Council on Library and Information Resources, 2002).
18. Abby Smith, *New Model Scholarship: How Will It Survive?* (Washington, D.C.: Council on Library and Information Resources, 2003).

The underlying challenges and opportunities share common threads, including the obvious themes of rapid technological change and how such changes influence the needs and expectations of researchers and users. Perhaps the deeper themes, however, involve the social and institutional changes necessary to effect the transition from traditional resources, tools and services for support of scholarship to the digital, distributed, seamless environments that will be necessary in the future.

Institutional repositories, scholarly communication and open access

The changes discussed in this section will have a profound impact on the creation, communication and reuse of research and learning outputs. This in turn will have a profound impact on how libraries are organized and the services they provide.

Open access and the institutional repository are huge trends but likely in ways we don't even know. Libraries are reinventing the wheel by trying to take on the roles of publishers. It's like a morality play: reclaim good and leave evil behind.

Director, National Licensing Project

Institutional repositories[19]

There is an growing interest in the more coordinated management and disclosure of digital assets of institutions—learning objects, data sets, e-prints, theses, dissertations and so on. This movement is in early stages and there are no settled patterns or standards. Recently, the term "institutional repository" has emerged as a general summary label for a range of supporting services the library might offer in this environment, working with faculty to provide curatorial attention to a dispersed, complex range of research and learning outputs. DSpace is an initiative of MIT and Hewlett-Packard, providing open-source software for institutional repository development, and importantly, a policy framework for thinking about the development and management of such repositories. Many academic libraries are planning institutional repository initiatives, and many of them are using DSpace.

The most significant challenge facing academic libraries undertaking these institutional repository projects is not technical, however. The major challenge is cultural. Too few initiatives include all the stakeholders—faculty, library staff, IT staff and instructional designers—and there is no common view of what an institutional repository is, what it contains and what its governance structure should be. Faculty have rarely involved librarians in developing teaching materials, digital or otherwise, and have not routinely made these available within the library infrastructure. Librarians have not routinely created metadata for such material.

Scholarly communication

Clifford Lynch directs our attention to the rapid rise in prominence of institutional repository technology as a primary signal of the changing needs of supporting scholarly communication. He applauds these developments, but also points to some of the inherent dangers that attend the evolution of new technology models. High among the risks he sees is the danger of broken promises—the possible discrepancy between the institutional

19. The OCLC E-learning Task Force White Paper discusses the topic of content management and institutional repositories in more detail. www5.oclc.org/downloads/community/elearning.pdf.

commitments and organizational limitations.[20]

A major issue here is that the outputs of digital scholarship are often in complex and nonstandard forms. We do not have routine ways of managing new media. The academic community will need to develop a better understanding of ways in which scholarship and learning activities are created, used, reused and preserved in the digital environment, and of the relationships and infrastructure necessary to sustain these activities.

Libraries need to be proactive about e-learning and not wait to be approached as a partner.

Academic Librarian

Open access

The institutional repository discussion is sometimes connected with an "open access" discussion. Open access is concerned with better and broader access to research and learning outputs. More specifically, it is interested in reducing the economic barriers to such access. Examples are:

- SPARC, the ARL-initiated effort to facilitate competition in scientific communication through the creation of high-quality alternatives to commercial titles and SPARC Europe, recently launched to provide a European operational arm for SPARC activities.
- The establishment of institutional- and discipline-based archives that allow public access to content and employ the Open Archives Metadata Harvesting Protocol.
- PLoS, the Public Library of Science, a nonprofit organization of scientists and physicians committed to making medical and scientific research publicly searchable and accessible.

The open access community is a broad-based movement with significant library support. See in particular the work of ARL in supporting SPARC, and the formation of the International Scholarly Communications Alliance (ISCA) by major library organizations worldwide that are dedicated to the pursuit of Open Access. The development of systems of e-print archives is supported by national initiatives in several countries.

Finally, we note a related set of discussions about access to the outputs of publicly funded research, and a strong desire to see those freely available to those whose tax dollars have supported the research in the first place. In the U.S. this discussion has been focused by the legislation introduced in Congress in June 2003 by Rep. Martin Olav Sabo (MN) to make papers written to report results of work funded by federal agencies free of copyright. Needless to say, this has generated a good deal of both pro and con discussion.

It is worth keeping in mind that the revolution in scholarly publishing and communication is now almost 15 years old. So far, the system of measuring and rewarding academic staff at universities has changed very little. This is a very complex ecosystem and adjusting one part of it does not necessarily yield the desired results. As one former academic pointed out in an interview with OCLC staff: scholarly publishing in journals has an archival function to it overlooked by many debates about open access to scholarly research. Researchers in specific fields do not rely on published articles to keep up. "Keeping up" is done through preprints, e-mail and personal Web sites.

20. Clifford A. Lynch, "Institutional Repositories: Essential Infrastructure for Scholarship in the Digital Age," *ARL Bimonthly Report* 226 (February 2003): 1–7.

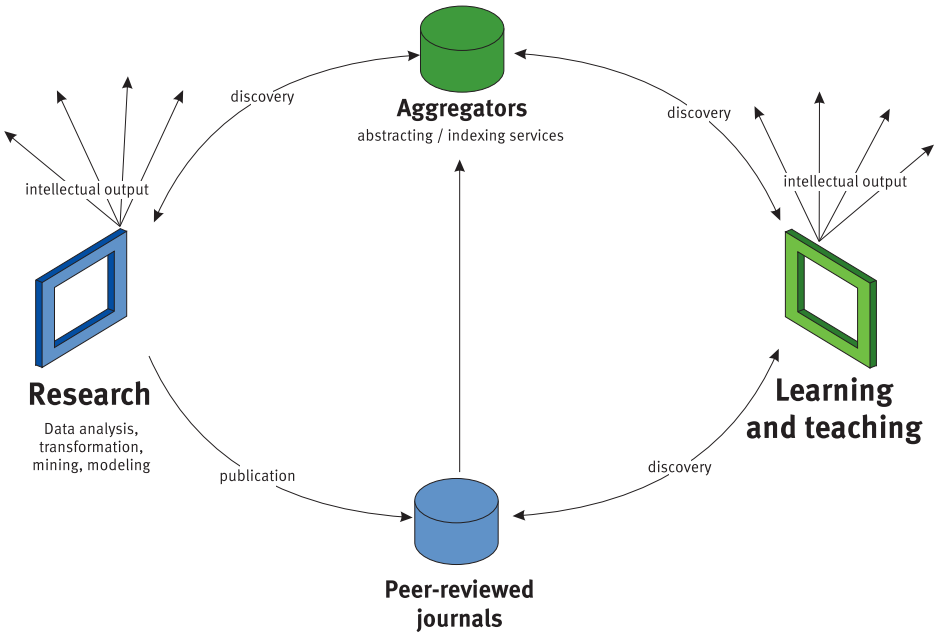
New flows of scholarly materials

It is clear that a new ecology and a new economy for scholarly information are being formed. At this early stage the players are working through issues, roles and responsibilities, models, territorial disputes and change. Because there is a lot at stake, it is difficult to know how things will turn out. We have moved from a landscape with well-understood contours to one that is still "under construction." The following figure (adapted from Lyons[21] with permission) aims to show how the new environment might look. Changing research and learning behaviors results in a flow of research and learning outputs that, in turn, form the inputs for new research and learning activities. In the past, such flows tended to be concentrated through formal, linear publishing mechanisms; we are now seeing the emergence of a variety of repository frameworks, metadata aggregation services and richer content interconnection and repurposing that are changing how we think about data and its uses. Elements in the flow include:

- **Repositories.** These may be institutional, personal[22] or community-based. They may be disciplinary or general. They may be specialized by format or general. (Try using Google to search "personal repository."[23])

Too many digital resources have been initiated by some entrepreneurial activity that is not sustained by real need or a community of interest.

Director, Funding Agency



Scholarly information flow—Then

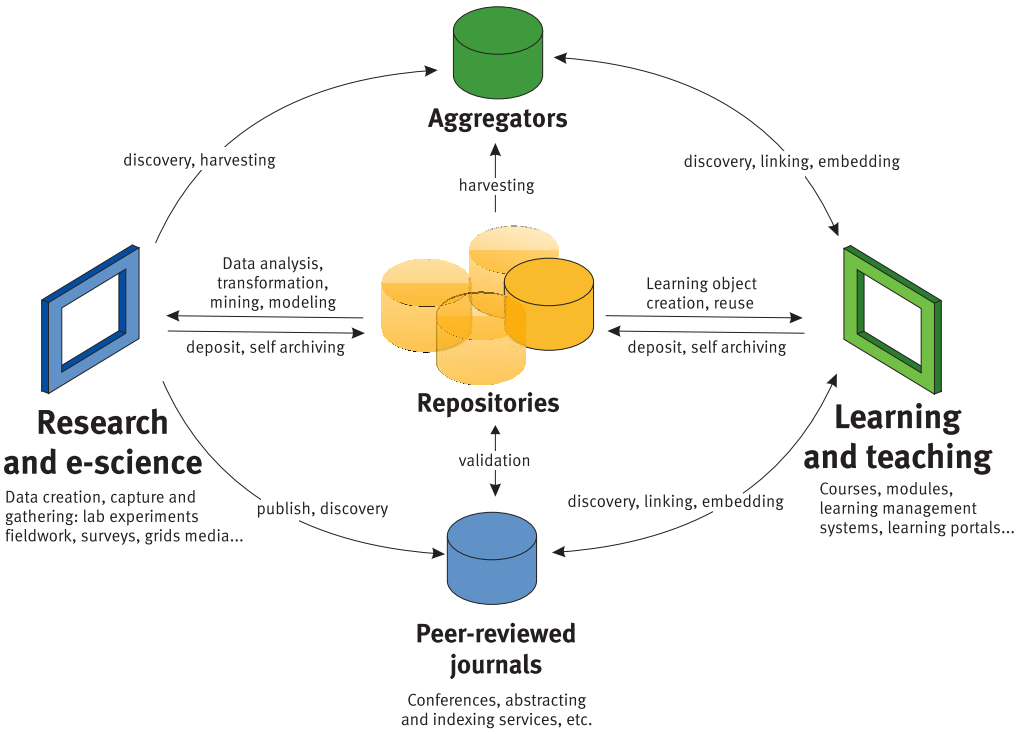
21. Liz Lyon, "eBank UK: Building the links between research data, scholarly communication and learning," *Ariadne* 36 (2003), www.ariadne.ac.uk/issue36/lyon/.
22. MyLifeBits is a Microsoft project for storing all of one's digital media, including documents, images, sounds and video.
23. www.archivists.org/publications/donating-familyrecs.asp.

The biggest issue related to institutional content is determining how to draw the line between helping faculty manage their content and in taking over curatorial rights to their content.

Academic Library Director

- **Aggregator services.** These may be commercial services or provided through community or central funding of some sort. ResearchIndex (formerly CiteSeer) is an interesting example of a popular aggregator for particular disciplinary communities.
- **The library.** Clearly, the library potentially intersects with this cycle at many points: as a manager of institutional repositories, as a licensor of external services, as a facilitator for deposit or self-archiving, as a local persistent repository provider. The role of the library as aggregator has yet to be worked out. But, the library has the opportunity to take a leadership role in developing policies and programs that contribute to a coherent, institution-wide knowledge management system.

Libraries are ideally placed to continue to build relationships and to provide the services that create value to their communities, and which corroborate their role as trusted hubs of community and learning.



Scholarly information flow—Now

Implications

- There needs to be a reexamination and refocusing of the roles of public services in support of lifelong learning and scholarship. *What are the points of contact between libraries and museums, public service broadcasting and education?*
- There is a widening gap between library services and systems and those in the e-learning and scholarly communication landscapes. *How do libraries of all types align themselves with the e-learning communities?*
- New learning and research needs may not be met by legacy services. *What services are required to support an informed citizenry, to create learning and creative opportunities?*
- New models of learning, research and scholarly communication will drive changes in the institutions that support this activity. *What changes should be made to the organizational structure of such institutions?*
- Changes in learning, research and scholarly communication will require that librarians become literate in information, collection and service architectures, and contribute to the design of such architectures. *How should library education change and adapt to accommodate these changes?*
- Lack of data format standardization, loss of poorly digitized and curated data, and lack of a common IT infrastructure imperil progress in integrating the assets of the cultural heritage and scholarly environments. *Given that there is likely to be little new money for asset management of digital material, how will libraries and allied organizations preserve, curate and provide access to digital collections?*