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ABSTRACT

This paper examines the inter-relationship between recent developments in information technology and the planning for the evaluation of the Educational Resources Information Center (ERIC) system. It argues that in the light of radical changes currently taking place in the networked information environment and user expectations, bold strategic planning is more important than formal retrospective evaluation. It identifies a number of key areas requiring careful consideration, including funding not only for centralized research and development but for innovation in the clearinghouses that are part of the ERIC system, and for explicit technology transfer mechanisms that migrate individual clearinghouse-based advances into infrastructure that supports the entire system. Further, it considers how environmental technology changes are reshaping the ERIC mission and context, with emphasis on a transition from database building to content access services and full text provision via the World Wide Web. It proposes that ERIC restructure its relationship to the literature of education, both formal and informal, and calls for the ERIC system to undertake a leadership role in coordinating federal government (and other) digital library initiatives as they relate to education as part of its role as a major component of the National Library of Education. (Author/AEF)

# Technology and the ERIC System: New Opportunities and New Impacts

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## Executive Summary

This paper examines the inter-relationship between recent developments in information technology and the planning for the evaluation of the ERIC system. It argues that in light of radical changes currently taking place in the networked information environment and user expectations bold strategic planning is more important that formal retrospective evaluation. It identifies a number of key areas requiring careful consideration, including funding not only for centralized research and development but for innovation in the clearinghouses that are part of the ERIC system, and for explicit technology transfer mechanisms that migrate individual clearinghouse-based advances into infrastructure that supports the entire system. Further, it considers how environmental technology changes are reshaping the ERIC mission and context, with emphasis on a transition from database building to content access services and full text provision via the Worldwide web. It proposes that ERIC restructure its relationship to the literature of education, both formal and informal. And it calls for the ERIC system to undertake a leadership role in coordinating federal government (and other) digital library initiatives as they relate to education as part of its role as a major component of the National Library of Education.

Introduction, Scope and Focus

The purpose of this commissioned paper, which is part of a series of papers that begin to establish a framework for the evaluation of the ERIC system, was to examine technology in the ERIC. Other papers in this series have covered the history and mandate of the ERIC system comprehensively, and I will not survey this ground again here.

I need to emphasize that I write this paper as a relative outsider to the ERIC enterprise; it is based primarily on documents provided to me by the ERIC community, conversations with members of this community, and some use of the online services offered by the ERIC system. I want to particularly thank those member of the community that provided feedback on the original draft of this paper that was presented at the March 8, 2000 meeting of the ERIC directors, either at that meeting or following it. This meeting was particularly enlightening for me because of the debate and discussion about some of the assertions in the earlier draft of my paper actually served to underscore very effectively some of the difficulties with the flow of information and innovation within the current clearinghouse system; I believe I have cleared up many of these issues in this revision, but I have included some comments about the issues that arose at the meeting. ERIC is a large, complicated, and sometimes

confusing system for people who don't work with it intimately. I fear that this report may still contain some specific omissions or errors of fact, particularly given the current very dynamic evolution taking place within the ERIC system, and I ask readers' indulgence for these errors; I do not believe that they invalidate the key points I am trying to make here.

Before going any further, it's essential to recognize – and applaud -- the numerous very real successes of the ERIC system over the past decades. ERIC has performed superbly, and provided a vital service to the American public and to the education community with amazingly limited resources. For much of the its institutional life, it has been at the forefront of developments in information science and information access. These accomplishments are well documented both in some of the other commissioned papers and in materials assembled by the ERIC system itself.

There are some points that need to be made forcefully about these accomplishments, however. The majority of the key innovations, at least in recent years, have been squeezed out of the clearinghouses and have not been specifically funded; rather, ERIC as a system is relying on the very deep clearinghouse commitments to providing the most responsive and high-quality ERIC services possible as a way of generating innovation (and, through this commitment, access to other external resources available to the clearinghouses). The marginal resources available through this mechanism

both to create new services and to operate these services once they have been established are approaching exhaustion; for example, it's clear that some new services, such as AskERIC, are not being publicized much for fear that demand generated by publicity would swamp the ability of the system to respond. There is no research and development budget for ERIC as a system, and the clearinghouses have been bearing the burden of making up for this. ERIC has historically taken great pride in its heavy use of leverage – not only through the clearinghouses, but through public-private partnerships to support core activities like database and document access. This is becoming an increasingly counterproductive and dangerous strategy, with ERIC (and the government broadly) losing control of the range and quality of services being offered, and with these services running the risk of being marginalized. If the point of the enterprise is to ensure wide access to education information, in the current web environment it is likely to be much more effective to explicitly fund free access than to insist that content be offered under commercial terms which constrain use but minimize investment by the Department of Education. If one goal of ERIC is to exploit developments in information technology to improve access to the literature of education, it needs to explicitly fund efforts to exploit technology developments. A review of these economic and policy assumptions will be a critical part of any full-scale evaluation of the ERIC system. Many of these issues are well-covered in an excellent recent paper by Lawrence Rudner, "Information Needs in the 21st Century: Will ERIC Be Ready?".

In my view, the questions that need to be addressed are not about what ERIC has accomplished, but rather about the strategic directions it should take as it enters the 21st century. In this sense, I see the upcoming effort that these commissioned paper are intended to inform as less of an evaluation of past practice than as an attempt to evaluate current needs of the ERIC user communities and opportunities for the ERIC system in order to provide a roadmap for future developments.

My feeling is that there is little to be gained from a narrow evaluation of the current and recent historical technology deployed in ERIC; among other considerations, information technology changes quickly enough to ensure that any such evaluation would have a strongly retrospective character and would be of little use in defining future opportunities for the program. Consequently, I've spent little time on these issues. To my mind there are two central questions that need careful and extensive consideration; they lie at the intersection of technology, audience and mission. The first, and unquestionably most important, is how environmental technology changes are reshaping the ERIC mission and context, creating new opportunities, new demands and new user expectations, and rendering long-standing practices and priorities less relevant and responsive. In other words, the nature of the literatures that ERIC organizes, synthesizes and provides access to are changing, as are the demographics, needs, capabilities and expectations of the ERIC users; these

shifts call for corresponding changes in the way ERIC approaches its operations.

The second question addresses technology-generated opportunities for ERIC to change and extend the way it operates to be more effective and responsive. Here we can view technology as propelling the future development of ERIC from within, rather than reshaping it from outside – a perspective of technological determinism, in a sense. This is less important than the environmental technology context, and indeed if considered in isolation from the changing environment, audience and expectations technology-driven opportunism is problematic if not outright dangerous; ERIC should not be implementing new technologies just because these are available and it can do so, in the hopes that these technologies will turn out to be helpful in some poorly defined way. Rather, the selection and deployment of new technologies needs to be driven primarily by the changing environment and requirements on the ERIC services.

There is also a third critical issue which is at least partially developed in this paper. Increasingly, ERIC no longer stands alone; rather it operates within the broader context of initiatives such as the National Library of Education (NLE), which in turn is part of an even broader and more complex constellation of federal initiatives to develop various types of digital libraries. These federal programs in turn are linked to state and local initiatives. This entire

constellation of programs is evolving very rapidly in response to funding opportunities, technology developments, and the emergence of operational prototypes. This context will call for a continuing reassessment of the work going on within the ERIC program and the strategies for connecting and coordinating this work with other programs. While far beyond the scope of this paper, I think that a clear case can be made for some formal coordinating mechanisms that span the entire constellation of programs, but in the absence of these mechanisms ERIC will need to take the initiative to perform such a continuous reassessment looking outwards from its own programs.

Finally, there is a central issue not so much about technology but about the management of technology, and in particular the management of technology deployment and diffusion throughout the ERIC system. As budgetary strategies have shifted virtually all technology innovation to the clearinghouses, where such innovation occurs on a highly distributed basis, approaches to ensure that ERIC as a system retains coherence and that these technologies migrate from one pioneering clearinghouse to the system as a whole – and do so in a cost-effective way that does not require each clearinghouse to evaluate and locally re-implement each new innovation -- are going to be vital. Similarly, individual clearinghouses are not only innovating, but as part of this innovation are collaborating with (and sometimes leading) a broad community of organizations with interests in technology, digital libraries, and education in areas such as standard development or the design and deployment of

experimental systems, and provisions are needed to tie these clearinghouse based efforts back to strategies for the ERIC system as a whole.

The reader should recognize that this paper is not intended to be a comprehensive evaluation, even within the constraints that I have already outlined. Rather it is intended to raise and define issues and criteria that need to be integrated into a full-scale evaluation and more importantly a strategic planning effort. Much of my goal here is to simply raise issues that have not been considered in the other commissioned papers. Evaluation naturally looks to the past and to the present; it is an effort to rigorously analyze how well the current system is doing. In this paper I will argue that we are in a period of rapid, radical change that is reaching into every part of our society, with some of the greatest changes occurring in areas related to technology-enabled access to information. I would urge the ERIC system to think boldly about its future in such a period; the potentials for what it can become are in some cases quite different from what it has been up till now, and cannot necessarily be justified simply by an evaluation of past performance.

External and Environmental Technology Trends and Implications

A decade or two ago there was little full text online, and even less non-textual material. Online databases – whether they were library online catalogs or

abstracting and indexing databases such as those created by ERIC -- were viewed primarily as a way to organize and provide access to print-based information (or surrogates for print, such as microforms). Access to online resources was largely limited to an elite group of academics and librarians, and these users were expected to receive specialized training in the resources that were available and how, when, and why to use them. Online access was expensive and thus rather carefully controlled. Government programs with responsibility for managing literatures in various disciplines – ERIC, MEDLINE, and AGRICOLA, for example – concentrated primarily on database creation rather than database access; to the extent that they were concerned with access it was largely with providing mediation and support in searching these databases through commercial database access services such as DIALOG.

In 2000, *none* of these environmental assumptions hold. Perhaps the most important changes are in the expectations of users. The general public has come online to the Internet and the Web on a huge scale; this includes many parents, students and practicing teachers, not merely people in higher education. There is a vast renewed public interest in the quality of education, and a much greater tendency to want to participate actively in the education process (much like the parallel trend in health care, where a distrust of the health care delivery system has caused patients to become much more aggressive in seeking out health information and using it to take greater control of their own care); emerging developments like home schooling only

underscore these trends. The types of material that are of interest to these new users is often quite different than that which preoccupied the academics who were early users of ERIC. Some of these new users are interested also in materials in languages other than English, and the web is becoming increasingly multilingual in character and thus potentially able to address these needs.

Indeed, because much of the new user community starts with web search engines as they try to locate relevant information, ERIC will need to ensure that its sites are appropriately indexed by these search engines so that users are quickly directed to them as authoritative sources. This is a new and very different "public relations" mission than distributing flyers or operating booths at conferences, and one that requires considerably more technical sophistication.

This new user community has already had their expectations shaped by their experiences with free and easy to use (though not always effective or unbiased) search engines that immediately deliver access to full text resources. These systems rank results to help the user to deal with "information overload" problems; in addition, some systems used by commercial sites (such as Amazon.com) also incorporate technologies such as reccomender systems that provide alternative pathways for finding items of interest. Multimedia – images, sound recordings, interactive programs, and video materials -- is

becoming more and more commonplace; the emerging broadband access technologies will greatly accelerate the availability and use of multimedia in the next few years. And we are now seeing systems emerging that attempt to provide people with *answers* directly, rather than simply citations to literature that may possibly provide an answer to a question.

The demand for instant gratification is real and pervasive. For example, journals in most fields that are not available in electronic form are starting to find themselves at a competitive disadvantage – in effect, slipping into invisibility – when contrasted with other journals that are available online. Access to the full text online need not be free and unrestricted, though this of course further increases the impact of network-accessible materials.

At the same time, there is a growing recognition that not all information accessible through the Web is of equal quality, and that in important, high-impact areas such as health, education, or financial planning information quality and information vetting is important; this is leading to a new emphasis on high quality, well managed, authoritative sites and source "brand name" recognition.

Access to computers has become sufficiently widespread that they are being viewed as tools for learning in their own right, and consequently there is an

expanded interest in instructional technology, courseware, web sites and "learning objects" as part of the information base that is relevant to education.

This is the new technology-driven environment in which ERIC must operate in the 21st century.

## Technology Trends and Opportunities

Technology developments offer tremendous promise for ERIC. We have moved from an era when storage was expensive and processing power (to support searching, for example) was very costly to one in which storage cost for not only the ERIC databases but the actual source textual documents that they describe is now very cheap. More and more of the documents that ERIC organizes and provides access to – or at least the documents that ERIC *should* be organizing and providing access to – are already available in electronic form on the Web. Information retrieval technologies – including not only pure searching technologies, but also ranking and multilingual information retrieval (at least in roman languages such as Spanish) – have advanced significantly over what was available 20 years ago.

There is no longer much justification or excuse in locking up ERIC content within expensive, hard-to-use, commercial information retrieval systems and

limiting access to this content, though such delivery channels may continue to be one of many legitimate and useful means of access to this content. Indeed, because ERIC information is public information and the ERIC system can be seen as having a mandate to make it broadly available, it is now likely to be among the least profitable information mounted on commercial information retrieval and access services, and the quality of these ERIC implementations is likely to continue to degrade as the commercial services focus more intensely on more restricted commercial databases, which should be a real concern for ERIC in moving into the new century. As a matter of policy, ERIC will need to continue to make its content broadly available for mounting by other commercial and non-commercial services (as well as providing access directly), but it will need to give serious consideration to defining and aggressively enforcing minimum standards of quality (in terms of both timeliness and accessibility) for these external implementations in order to preserve its reputation as a quality source of information in education.

New technologies and infrastructure components have become important. One major example is persistent naming. ERIC assigns identifiers; with the recognition that persistent identifiers (i.e. Uniform Resource Names) are essential for archiving, citation, and inter-document linkage in the networked information environment, services that assign such identifiers are taking on new importance. A second example is the actual process of inter-document linkage enabled by persistent naming. A third is managed archival storage

under the stewardship of responsible organizations that ensures that documents will be accessible for the long term (for example, e-print archives). As discussed later in this paper, ERIC needs to very deliberately consider its role as part of the infrastructure to support access, organization and maintenance of the literature of education (broadly defined) in the networked information environment.

Metadata standards (Dublin Core, IMS, etc) and technologies to associate metadata with web pages or other networked information resources is becoming practical, at least in conjunction with selective web indexing that uses this metadata. This allows distributed description of content and improved access to that content – including content that cannot be directly indexed in the form of static web pages such as databases that are presented to the user as dynamically generated web pages in response to a query. (Metadata in the uncontrolled public web is more problematic because of the prevalence of "index spammers" who provide erroneous metadata in an attempt to manipulate the behavior of search engines. Deploying metadata in the public web will require digital signatures on metadata and trust management systems to assess and manipulate these digital signatures). We are now seeing the emergence of subject-specific web "portal" sites (such as the work of the ROADS project in the UK) which build on these new technologies.

There are also emerging technologies that can be used to deploy question-answering databases (as opposed to search engines); these offer tools that can be used to move beyond literature indexing. Further, these automated tools permit reference service delivery, at least at some level, to be offered 24 hours a day, 7 days a week, which is more consistent with the general expectations of web users. It is worth noting that libraries (including institutions such as the Library of Congress) are currently exploring how to use these technologies in support of 24 hour a day reference services; since education information is one of the core subject areas of interest to the general public, ERIC will need to ensure that its materials are effectively integrated into these reference services.

In the past two years, there has also been important progress in standards and best practices for accessibility of networked information by people with disabilities through the efforts of the World Wide Web Consortium. This has emerged as an increasingly important issue as the ERIC user community on the web becomes broader and more diverse. ERIC will need to mount a systematic initiative to ensure that it is incorporating these standards and best practices.

I want to be very clear here that I am trying to provide a broad view of technology developments that are important for ERIC; I am not suggesting that the ERIC system as it stands today is unaware of, or disconnected from, these developments. Indeed, some ERIC clearinghouses (most notably, the

clearinghouse on Information Technology based at Syracuse University) have been not only been deeply involved in many of the developments and projects I've mentioned, particularly in areas such as metadata standards for educational resources, online question answering systems and the like, but actually have played important leadership roles in the initiatives. The great challenge facing ERIC as a system in the 21st century is how to move from initiatives based at individual clearinghouses to a transformed and restructured set of services – including core services not based at clearinghouses and a coherent set of clearinghouse-based services -- that fully exploit the potential of the technology trends described above.

A Review of ERIC Services from an Emerging Technology Perspective

At a very high level, ERIC incorporates the following user community services:

- It indexes the published literature in education.
- It organizes and indexes the "gray" (not formally published) literature and also archives and provides access to this gray literature.
- It develops and publishes digests and other syntheses of the literature in key topical areas.
- Through its clearinghouses it provides specialized pathfinders, summaries and analyses of developments in key areas of education. These are increasingly moving to the web.

- It answers questions from the public – submitted through telephone, letter, or e-mail. This is done primarily through the clearinghouse system.

In this section, I will consider each of these services in the context of the changing technology environment.

*Indexing the Published Literature*

In this area, ERIC needs to recognize that the published literature is inevitably moving into electronic form, and that the parts of the literature that do not make that transition soon will become increasingly less visible and less relevant to the vast majority of readers.

ERIC needs to rethink and renegotiate its relationship to publishers in the education disciplines; the work of the National Library of Medicine (NLM) with PubMed can serve as a good model in this area. There is a need for an ongoing dialog between ERIC and the publishers, and the ERIC system needs to take some leadership within the education community in reshaping the system of scholarly publishing there. Specifically, ERIC needs to explore the following issues:

- Linkage between ERIC records and on-line versions of articles.

- A more current database through a two-phase submission process; the first phase would just incorporate a bibliographic citation and perhaps an author abstract that is obtained directly from the publisher, preferably electronically, with human analysis from the ERIC system following in a second update.
- The potential role of the ERIC system as a "backbone" for the literature, as well as an access vehicle: specifically, the use of an ERIC service that permits the user to move from a citation in one article to the actual cited article in another publication, with resolution managed through the ERIC database. PubMed has been doing this for several years, and it is a very important service for both readers and publishers.
- The implementation of an "e-print" archive, similar to what has been done in high-energy physics at Los Alamos or what is being proposed in the life sciences by NLM. Such an archive would allow authors or publishers to deposit articles at some point during their life-cycle (perhaps in preprint, or immediately after publication, or some years after publication, when much of the commercial interest in the materials has passed) to make them much more widely available. The e-prints, of course, should be linked to the ERIC bibliographic database of the published literature.

I understand that there has been an ongoing issue about how the ERIC bibliographic database relates to various private sector database efforts. In my view, as the literature being indexed increasingly moves to electronic form, the issue will move away from bibliographic databases and towards organizational

access systems for literatures represented in electronic form. I think that the case can be easily made that such an access apparatus is best provided by a neutral noncommercial party such as the ERIC system.

*The Gray Literature*

The key point to consider here is that the nature of the gray literature is changing, as are user expectations about its accessibility through ERIC. More and more of it is non-textual, and much of it is at least created in electronic form. ERIC needs to broaden the scope of the material that it covers, and to move away from microform distribution of this literature and towards an electronic archive model which stores the material and makes it freely available as a service to both authors and readers. This material can also be linked to the published literature through the same system that provides inter-article linkage within the published literature. ERIC needs to decide whether to move away from its current role as a document delivery broker, or else to analyze what would be involved in actually becoming what is in essence a "publisher" for the gray literature, collecting revenues on behalf of authors and employing copyright technological protection systems to limit the redistribution of these materials. I suspect that the latter role would be problematic from a policy basis.

*Databases vs. Services*

R. David Lankes, in his paper "Adjuncts, Affiliates, and Partners: Building an ERIC Network for the 21st Century", make a critically important point. ERIC has historically be concerned with creating and distributing datasets, or databases, rather than providing access to services that provide access to the literatures. While there is certainly continuing merit in distributing datasets, my view is that ERIC needs to reorient itself so that it is the primary access service to the databases it develops and maintains. (Again, the parallel to the National Library of Medicine and the MEDLINE database there is very striking). By making such a shift, ERIC can assure universal, high quality access to these databases and to the electronic full texts behind them (as discussed above).

Providing such services was probably prohibitively expensive ten years ago; today, it is affordable, feasible, and, I think, necessary. As well as ensuring ubiquity of access and quality of service, it directly connects ERIC with its users, which is important not only in building support for the program but also in building community, and in ensuring that the ERIC system closely tracks user needs and interests on an ongoing basis. The quality of service standard established by the ERIC service can also be used as a benchmark for ensuring that other commercial or noncommercial implementations of the ERIC databases maintain acceptable quality of service.

As mentioned earlier, as part of this shift in emphasis to delivering services rather than datasets, there's a need for a systematic program to make ERIC visible through internet service directories and search engines, and to consider where opportunities exist to dynamically federate ERIC services with other digital libraries and databases.

*Clearinghouses, Innovation, and Content Creation*

The clearinghouses are more and more becoming the public "face" of ERIC. In a world where bibliographic citations are commoditized, they create most of the original "content" and answer most of the queries from the public. As already discussed, the clearinghouses are also serving as the *de facto* locus of virtually all of the technology and content innovation within the ERIC system.

I do not have a set of crisp recommendations in this area. However, there are a number of questions that need to be considered. It seems likely that the locus of technology innovation will increasingly shift to the clearinghouses; even if a central ERIC system research and development budget is put in place, because the clearinghouses are most closely connected to the needs of the users and the developments in relevant content areas, they will remain a natural crucible for innovation that will complement and extent any sort of central research and development. Funding provisions will be needed to underwrite at least some of this research, development and innovation at the

clearinghouse level. Perhaps even more importantly, are there effective mechanisms for technology transfer from one pioneering clearinghouse to the other clearinghouses? There is a need for the ongoing development of "universal" system-wide infrastructure that can support all of the clearinghouses – or at least all that want to take advantage of it – based on the best results of local innovation at individual clearinghouses; it is counterproductive to expect each clearinghouse to individually reimplement the results of such innovation, once proven at one clearinghouse, locally. Similarly, one can reasonably ask if content created by the clearinghouses is effectively linked into the broader world of internet service directories and web indexing services, and if not should this be done as a central service function or piecemeal by individual clearinghouses? And finally, it's clear that effective communications mechanisms that permit clearinghouses to share information about innovation, and about their participation in national and international initiatives beyond the ERIC system will be of central importance.

ERIC is increasingly a distributed system. While I suspect that historically there have been tensions between centralization (and the primacy of centralized core services) and distributed clearinghouse-based services, I do not believe that a debate about the extent to which ERIC should be distributed is productive moving into the future. Rather, I believe that the fundamental question is one of coherence: a user should be able to start at any clearinghouse, and be able to access the resources of ERIC as a system from that starting point. All

clearinghouses should offer a set of common services (including question answering and access to database resources) leveraging the investment in the entire ERIC system which form a foundation for their unique content and service offerings.

The evidence suggest that there are major problems in this area. For example, at the March 8 meeting, I suggested that one example of a modest, easily-implemented but valuable service which would increase coherence would be the ability to search all of the ERIC web sites from any clearinghouse. The good news was that such a service actually existed. The bad news was that many clearinghouses did not realize that the service existed (and in fact was over a year old), and didn't implement it. This simply underscores the need for mechanisms to ensure that a common technology base encouraging coherence is in place to support all the clearinghouses.

Research Questions

ERIC has carried out some important research and development over the years in areas such as the effective indexing of the education literature. To the extent that it defines its future mission to include organizing, providing access to, and archiving the literature of education, an expansion of this R&D function

into other areas is likely needed. As well as continued – indeed, renewed – research in how to provide access that enlarges its focus to consider the general public rather than educators as audience (such as metadata standards), it would be reasonable to launch work on document structuring and markup (for example, XML) and the broader and more difficult problem of knowledge representation in education, and linkages between datasets and "learning objects" on one hand and the literature on the other.

The other key research area has to do with audience. ERIC knows a good deal about its user communities, but there will be an ongoing need to track how the demographics of these user communities change over time. And, as discussed earlier, personalization technologies can be a very powerful tool in improving service to users. However, these questions much be balanced against both legislative and policy recognitions of the need for user privacy, and in some cases, anonymity.

## The Broader Context of Digital Library Initiatives

Digital library initiatives are emerging everywhere today. The Department of Education has launched a National Library of Education (NLE). Efforts are underway to bring together agencies as diverse as the Institute of Museum and

Library Services, the Smithsonian, the Parks Service, and the National Science Foundation to provide educational resources on the net. The National Science Foundation, working in collaboration with the Library of Congress, the National Library of Medicine, ARPA, NASA, and others, continues to support a major research initiative in digital libraries. And NSF has a sizeable specific program to develop a digital library to support Science, Mathematics, Engineering and Technology Education (SMETELIB). All of these both inform and connect with the ERIC program.

At the same time, there is a growing state-based focus on educational standards, and development of K-12 curricula rests primarily with state and local government, not with the federal government. Some of these efforts are now being linked to state-based developments in instructional technology and digital libraries. Linkage mechanisms will be needed to coordinate these efforts.

Some consideration should also be given to digital library initiatives in other nations. This, of course, begs questions about the potential international scope of ERIC's coverage. Similarly, there are private-sector initiatives such as the Instructional Management System which has emerged from the Educause National Learning Infrastructure Initiative which will also have important connections with the future of ERIC and the National Library of Education.

There is a real need for ongoing coordination of these efforts, and a further need to ensure that the future strategies for ERIC recognize and complement these other programs. In some cases, such as SMETELIB, technical and operational linkages – perhaps even explicit service federation -- will be critical.

I believe that a key part of the evaluation and future strategic planning for the ERIC system must include the definition of an ongoing coordination and information-sharing mechanisms for government-wide digital library initiatives, at least to the extent that the focus on education rather than research. One of the specific questions that will have to be resolved as part of the development of these mechanisms is the role of ERIC clearinghouses in the process; today some of the clearinghouses are deeply engaged in national digital library issues, but it is unclear how this participation links back to ERIC as a system, either in the dissemination of information or the formulation of policy positions.

## Conclusions

The public is increasingly seeking high-quality information through the Worldwide Web. The three areas that are often listed as most popular, and most critical, are medical and health information, social services, and financial

and investing information. In each of these government-provided information resources and services play a critical role.

I think there is a growing body of evidence that education information is emerging as the fourth such sector. Massive public opinion and behavior shifts are at work here that make members of the public much more concerned about access to education-related information. The National Library of Education is the obvious initial point of contact for these information needs, and ERIC – which has been aptly described as " a major load bearing wall" of the NLE – is certainly the most mature and well-developed operational service to address these needs.

In evaluating its current practices and planning for its future, I believe that ERIC can learn a great deal and gain important insights by looking at the work that has taken place in other areas – particularly the medical and health arena. The health and life sciences have been generously funded, and have enjoyed access to some very sophisticated technology (such as the work of the National Center for Biotechnology Information at the National Library of Medicine). I would urge that the full evaluation and strategic planning effort for ERIC include some forum, such as a workshop, that looks specifically at the similarities and differences between the evolution of the ERIC system and the NLM-based initiatives to provide health information to the public. I think there is a tremendous amount to be learned here.

Technology changes are reshaping the entire information ecology within which ERIC operates. In my view, an evaluation of the ERIC system from a technology perspective needs to focus not on the details of the use of technology within ERIC, but on the ways in which this information ecology is changing; this will point to many changes in the portfolio of services that ERIC offers. And that, in turn, will dictate changes in the way that technology is actually harnessed within the ERIC system. I hope that this brief paper has at least highlighted some of the key environmental changes that are taking place, and outlined some of the ways in which the ERIC system might reorient itself to respond to them.

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