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## **Integrating Libraries into the Curriculum: The CHIPS Project**

### INTRODUCTION

Libraries have played a role in support of teaching, but only in rare instances have they had a key role. Of course the faculty use library resources in preparing lectures, and there are often substantial collections of reserve materials drawn from the library, but these represent passive roles. At Columbia University Health Sciences, we are creating a pivotal role for the library with the Columbia Health Information PerspectiveS project (CHIPS). The objectives of the project are to promote the development of the curriculum as an integrated whole; to create an electronic curriculum that enables students to move through the learning process with a significant degree of control over how and when, where, and in what sequence they learn; and to track the progress of students against individual objectives, course requirements, and learning timelines while providing tutor-like assistance.

### A HISTORY OF FOLLOWING

Libraries have been called the heart of a university, an appellation we librarians would like to believe is true. Various aspects of reality, including fiscal constraints, paint a somewhat different picture. In the area of curriculum support, perhaps we see most clearly the supportive, secondary role libraries play. I am referring to the traditional reserve room operation where faculty call for a variety of materials, some from the collections, some not, to be put aside for students' use. We have, in some enlightened libraries, allowed students open access to reserve materials. In other cases, we have invested in methods of providing some of the information online. Yet by and large we have played a passive role.

Another intersection of libraries and the curriculum occurs in classroom lectures on library use and library resources with occasional collaboration between a faculty member and a librarian in the design of an assignment emphasizing library skills. However, professional education in medicine tends to be intensive and highly structured, so that faculty often prepare extensive

syllabi for students' use. There is little time in the curriculum for students to do research, browse, or explore topics until the end when, in some cases, a minor "thesis" is assigned to justify the D after the M or J.

While librarians worry about the cost of publications, the lack of standards in CD-ROM products, teaching Internet skills, and a host of other issues, our parent institutions are facing major problems in the delivery of education. It is certainly true that library budgets represent competition for resources with hard-pressed instructional needs, yet I contend that librarians have skills and resources that can be an important part of the cost-effective delivery of instruction.

### MANDATES FOR CHANGE

Several compelling reasons argue for a reexamination of the delivery of education. While each of our institutions stands apart from its peers in some ways, all of them stand with their toes up against the same line in two notable areas: the constant need to incorporate new information into the curriculum and the concern over the cost of education. Though the "I lecture, you listen" method has been used for centuries (millennia?), its shortcomings have become ever more glaring over time.

#### **Knowledge Expansion**

One can trot out any of the hundreds of studies that show the unparalleled rate of growth in information today. We have all read those studies, and, more importantly, we personally feel the effects as we ourselves work to stay current. The information impacting on a science-based curriculum is not incidental—it is fundamental and complex. How do we decide what to include in a course, and how do we incorporate it with as little effort as possible?

#### **Pressure on Faculty**

Many of you know first hand the pressure on faculty for research, publishing, finding outside support, participating in the broader community as reviewers and panelists, and participating in the more immediate community on committees and task forces. These comprise the typical path to promotion and tenure, where value is measured in research dollars and numbers of articles published. Teaching, on the other hand, is like the weather—we talk about it a lot, we believe in it, but just as we are lousy at predicting the weather, we are terrible at applying quantitative (or even qualitative) measures to teaching. Partly as a result, excellence in and dedication to teaching do not carry much weight outside the home institution (however well they may play within). The rational faculty member allocating effort cannot fail to realize that teaching and counseling reduce mobility, while scholarly and professional accomplishments increase it. It is also true that college teachers, having never been taught to teach, are seldom good at the nuts and bolts of organization and curriculum development, the craft skills provided to our K-12 teachers by the much-maligned education schools. In addition, many good intentions in higher education run aground on the shoals of photocopying, copyright, and

other sources of minor frustration and delay. Is there a way to provide faculty with meaningful support as they go about creating new courses, revising old ones, and making choices about what to include and what to leave aside? Can we offer meaningful alternatives for the delivery of information to supplement the lecture environment?

### **Curriculum Revision**

As I mentioned, there is a constant need to incorporate new information and to rethink existing information in the curriculum, particularly in professional education. Among medical schools, there is currently a major effort across the country to get students out of the large lecture hall environment and into problem-solving groups. It is amazing to realize how rare collaborative work is for students in higher education, especially college where it tends to be labeled “cheating,” when one considers how vital teamwork is in the world of professional practice. Except for professional schools, it is uncommon to have massive revisions of an entire curriculum, but in those instances, we need to consider how we make such revisions rational, interwoven, connected, and continuous.

### **Varied Learning Styles**

We are not all alike. Some of us learn better from seeing an idea written out; some prefer images and graphics; some do best hearing an idea explained. In the mainstream of the curriculum, we do not—cannot—take heed of that. It is left to the initiative of the individual student to seek augmenting materials that support his or her learning style. Just as we have broken away from the notion of a uniform look to a catalog entry in an online public access catalog (OPAC), can we be more attuned to learning styles and provide information in more forms in order to facilitate and individualize students’ interaction with the curriculum?

### **Variety of Media**

The original medium for instruction was the spoken word, and the oral tradition included elaborate systems for memorization; then came writing—slow and laborious; then the printing press; then typing and telephonic devices. The computer era—began not so long ago—has generated vast changes in how we store, transmit, and access information. Videotape, audiotape, CDs—both video and audio—laser disks, camcorders, laptops, palmtops that are more powerful than some early mainframes, and so forth. How do we effectively, and in an integrated way, direct this array of media and technology toward helping students learn?

### **Structure of Information**

We can look with genuine pleasure at the beauty and simplicity of the printed text—particularly as manifested in the earliest books. Today, though, information is commonly found as molecular diagrams, chemical structures,

dynamic wave formations on a CRT screen, MRI scans, or microscopic camera images from inside the knee. The alphanumeric keyboard symbols no longer suffice. Again, how do we effectively utilize these new kinds of information and the accompanying technology to the benefit of the student?

### Continuing Education

The “half-life” of a bachelor’s degree in engineering is five years; that of a librarian’s master’s degree is, in my estimation, even less, considering the change in media and technology and the explosion of knowledge to be acquired, organized, and made accessible. The medical profession and, interestingly enough, medical librarianship as well have recognized the need for continuing education in their certification or credentialing processes. If, as will be the case for Columbia, we train health science professionals in a different way, that is by using more technology and reassessing the role of memorization, can we not also provide graduates with continuous updates to their knowledge? The learning process does not stop at graduation, but our information-based relationship with the student does. With the Internet and increasing connectivity from every part of the globe, might we not have options for a longer term relationship and a more extended/protracted role of the alma mater in lifelong learning?

### Cost of Education

Our current health care crisis mandates that the cost of education be the first consideration, and I would have put it at the top of this list save for the fact that we know so little about the costs of education. We do know that a massive study conducted by the Institute of Medicine in 1974, *Costs of Education in the Health Professions*, yielded figures that ranged from \$6,900 to \$21,000 per student for four years of education. Extrapolating *only* for inflation and not counting for increased use of technology, the cost moves up to a range of \$21,000 to \$56,000. Can the use of information technology in the curriculum save money in the delivery of education? We sincerely hope the answer is yes.

## ENABLING FACTORS

Three critical elements are converging to facilitate the kind of change in curriculum delivery for which I have argued. The first is the proliferation of reliable, high-speed networks—local, regional, national, and international. These electronic highways, as they are so frequently called, make it possible to share information resources, collaborate interactively with colleagues, and redefine the boundaries around the user populations we serve.

The second enabling element is the availability of powerful portable computers with excellent screen resolution, fast processors, and large amounts of memory. These increasingly affordable devices will make it possible for students to create individualized learning materials—notes from one course, images from another—blended together in a way that makes sense to the individual student.

Third is the availability of information in electronic form. While not a new phenomenon, it is finally reaching a critical mass, making worthwhile the efforts needed to create systems that rely on such information. It would appear that available tools such as Wide Area Information Servers (WAIS) and Gopher can be used in accessing text and images in reasonably standard ways. If that is true and we no longer have to worry about building fundamental tools, we can, instead, concentrate on individualized user interfaces that will make the difference in whether a system is used or ignored. It is the interface and application areas that are the focus of our project.

### MEETING THE CHALLENGE

Many schools have undertaken highly visible efforts focusing on technology in the classroom. Multimedia computer aided instruction (CAI) programs are often used to teach concepts. Hypertext network-based textbooks allow students to follow a variety of paths, check what they have learned with simple quizzes, and move on to the next section. Some medical and dental schools have developed databases of curriculum information to track the amount of lecture time devoted to particular topics, maintain a record of which faculty member is responsible for particular segments of the curriculum, and aid in scheduling classes.

All of these efforts are important, in good measure for what they teach us about how to design better systems, but they tend to remain disjointed, lacking an overall plan or vision for exactly how they work together and how they fit into the curriculum.

The project at Columbia approaches the matter from a fundamentally different point of view. We are creating an "electronic curriculum" that will accompany students through their professional training and into their practice. We are formulating a student-centered, networked-based curriculum environment that functions from an underlying knowledge model linking information resources unique to Columbia with those developed and resident elsewhere in the world. The project is called CHIPS, the Columbia Health Information PerspectiveS project. The user will have the ability to view the curriculum from many perspectives—the perspective of a student of nursing, medicine, public health, dentistry; a perspective attuned to a student's learning style; a perspective that threads an idea across various "courses" and across years and disciplines; the perspective of a faculty member wanting to augment a lecture or an administrator compiling a report for an accrediting agency, and so forth. The vision we have for the educational environment reverses the usual learning model in which it is assumed that the writer of texts, or the individual giving the lecture, knows what the student needs and in what order. We take the view that students are capable of directing much of their learning and that they can learn more effectively and efficiently when self-directed.

The CHIPS project, encompassing the schools of medicine, dentistry, nursing, and public health, will become a medium or mechanism for the exchange of information within the various components of the curriculum. It will foster a highly collaborative environment among faculty as they engage in developing aspects of the electronic curriculum. The vision of CHIPS is

to create for the student a learning resource that combines aspects of the library with aspects of tutoring and testing, and includes the added benefit of 24-hour accessibility, from any location.

### COLUMBIA HEALTH INFORMATION PERSPECTIVES

Figure 1 is a high-level schematic of the elements of this project. The drawing can be read in several ways: the upper portion represents work that we anticipate will be done locally (develop a knowledge map, analyze course material, create image files, standardize concepts), while the bottom portion suggests the numerous projects and products external to Columbia to which we want to link. Reading left to right, one sees information resources on the left and a mapping or linking device on the right. The shaded areas dividing sections are interfaces which are pierced by dotted lines representing queries or pathways. As the figure suggests, we will be assembling a variety of existing curriculum materials from course notes, bibliographies, syllabi, images, and graphics, and we will be mapping them into a structure that is loosely represented on the right side of the figure. This knowledge map or concept space is intended as a mechanism for browsing the intellectual content of the system, as well as a mechanism for providing directed pathways through required material.

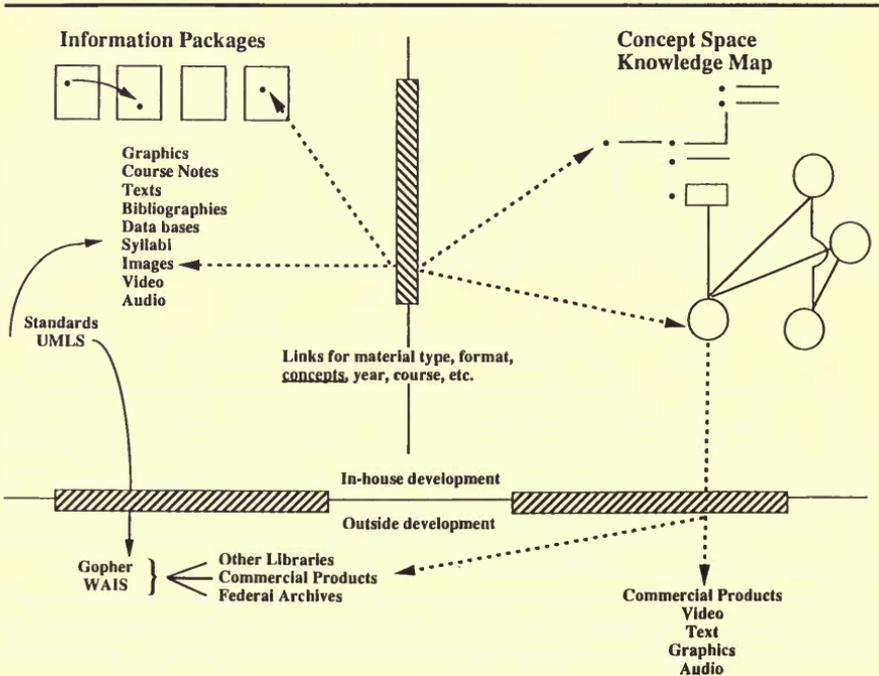


Figure 1. Elements of the CHIPS project

The work of implementation will be divided into at least three stages. The first is under way. We are gathering existing paper-based curriculum materials and analyzing them for content, structure, and overlap, and we are building a prototype of a segment of the knowledge map. Because I have participated in most of the curriculum revision meetings held in the medical school since July 1992, course directors are aware of our intention to build CHIPS and they are actively making suggestions on what to include—in particular what to off-load from the lecture environment into the electronic environment.

In this first stage, we are, in effect, building the electronic counterpart to the library's collection of books and journals. As much of the book and journal collection as we are able to acquire in electronic form will be part of the knowledge base, along with materials such as still images, digitized videos of surgical and dental procedures, and audio materials.

The second stage is building the curriculum model. We are beginning with medicine but will eventually encompass the schools of dentistry, nursing, and some aspects of public health. The job involves building a generic skeleton of health sciences knowledge to which will be attached the various information resources. We will use the Unified Medical Language System (UMLS) of the National Library of Medicine as a mapping device to link not only resources at Columbia but those that will be developed across the country. The stability and adequacy of UMLS is only one of many questions that face us in this project.

In the third stage, we will develop and then build the links that bind the information resources—the images, the animation, the full-motion video—to the skeleton that is the curriculum model. It is our intention to create only those information resources that we cannot acquire from others, whether commercially or on an exchange basis. As a result, there is considerable room for collaboration across schools. The linking will encompass the various "library" information resources as well as the clinical information system already in place at Columbia Presbyterian Medical Center.

This last stage also includes building the pathways for the students to use in moving about the resources, perusing new knowledge, taking tests on material, or being tutored. Some pathways will be prescribed, and traversing them can be monitored on a student-by-student basis to be sure that all students have completed required segments of the curriculum. Other pathways will be developed by discipline experts to help students learn how to think about a problem and how to ask the right questions in analyzing a patient case. In addition, students will be able to wander, pursue ideas, or create their own pathways, eventually to be either kept or erased.

### BACK PLANE ISSUES

At least five issues present major challenges to the realization of this project—and that leaves aside politics. First, how will the system look and work from the user's perspective? This is one of the most critical elements in any system. We have enlisted the active participation of a group of medical students in the building process, and it is our intention to listen to them, particularly on the topic of the user interface. Ultimately the users must be

able to configure the interface to meet their needs rather than be forced into a single approach to the system.

Second are issues related to the programming environment. We hope to use as many publicly available tools as possible in order to facilitate connecting to external resources and, of course, to cut down on tool development and concentrate on the knowledge base. We know there are good search engines out there, and work external to Columbia is underway to identify and organize information resources on the network. The work being done by the Clearinghouse for Networked Information Discovery and Retrieval (CNIDR) is critical to this project and others like it. We are pleased to be affiliated with CNIDR and support the efforts of George Brett and his colleagues.

Third, how will we model the knowledge to take advantage of its properties, its complexities, in a way that will elucidate and not obfuscate the learning process? While many knowledge-structuring schemes are available, the rules for applying them are highly interpretive, and the issue of compatibility between our project and work that may be done elsewhere presents itself. The same may be said for the interconcept links that will create the pathways. No agreed-upon set exists—most are ad hoc and often unique to a project's needs.

Fourth, there is an overriding need to make the system operate across multiple platforms—DOS, UNIX, and Apple being the major ones. This problem may be resolved by separating the access mechanism from the user interface/display mechanism and closely adhering to a standard structure within the access mechanism. There was a time when one would, for reasons of programming necessity, choose a hardware/software environment, IBM and DOS for example, and build a system in that environment. The choice was necessary because the various environments were independent of each other, with few communication options across platforms and virtually no collaboration between hardware or software vendors. By 1990, we began to realize the need for interoperability and the notion of closed shops went the way of centralized computing. Unfortunately, we are not yet very far along the road to having a software environment shared by, for example, IBM and Apple. This presents the CHIPS project with a major challenge.

The fifth issue concerns the need for faster network connections. When we start moving full-motion video around the network or still images that are  $1,000 \times 1,000$  pixels, we need gigabit network speeds. Like shared operating environments, gigabit speeds are out there; the question is when will they be on our campuses?

#### PAYBACK

Now let us leap over all the difficulties and ask: if we manage this—if we create this extensible, interdisciplinary tool, a tool that fosters learning and collaboration—how will it address the educational issues I raised earlier?

The first payback will come from off-loading some information from the classroom to the system, resulting in a better use of the classroom experience and opening up time for more small-group learning and problem-solving sessions.

The second will be easy integration of new information. In order to accommodate the expanding information base, the system will have to remodel itself, that is, as much as possible the structure of this system has to support

dynamic links between information and structure. We cannot possibly either hard-link or hand-link the information resources to the appropriate parts of the knowledge model and accommodate the necessary and frequent influx of new information. An interesting question that arises here is how to maintain a dynamic system that is stable enough that the user can be comfortable with it. It would be exasperating to walk into the library and find it arranged differently from one week to the next, even if the changes were being made to improve service or incorporate new material. Where is the right compromise between stability and flexibility?

Once implemented, the system should be tuned to integrate new information and greatly facilitate eventual changes to the curriculum. This will include providing tools for examining the curriculum, growing it here, pruning it there. The curriculum becomes an entity in its own right—an asset like the library, the laboratories, and other capital investments of the university.

Although CHIPS is student focused, it is also intended to be a tool for faculty—to find appropriate information resources, to update lecture materials, or to incorporate visual material into the lecture. In addition, course directors should be able to use the system to orient new faculty—that is, it should be easy to get an overview of a course in which a new faculty member has been asked to participate; it should be easy to see what has been covered, what is planned, and how it fits with other lectures.

The system will use as one of its advantages the incorporation of a variety of media and ways of presenting information. It will accommodate differences in learning styles and variations in the pace of learning to the advantage of the student. In addition, by being network based, it will be time- and place-independent. These are major paybacks for students.

The potential value of the CHIPS project as a link between health sciences graduates and their need for continuing education is enormous. Because such a system is globally accessible, we can consider forming long-term information-based relationships with graduates. In fact, it strikes me that there may be an obligation to do so. If we are successful with the project, we not only will have made changes in the way education is delivered, but we may be changing the premise of what an education in health care is. Faculty in curriculum revision meetings are already deliberating questions of what needs to be taught face-to-face in the classroom and what might be off-loaded to CHIPS; the next step is to question what the role of the information in CHIPS is. Some information will clearly be there to be learned and memorized, and will come out in test scores. But clearly other segments or layers of information are there as resources to be used when needed, not memorized.

The last item is the cost of education—we don't know with any certainty how CHIPS will affect costs, but it is on the agenda as an item to be watched and studied as we proceed with this project. Efficiency in the use of faculty time, convenience to students, and tapping national information resources all come into play, and all are hard to quantify.

#### CHANGES TO THE LIBRARY

What does CHIPS bode for the library? You might ask whether the library is getting closer to the curriculum or farther away. It is my belief that the

more transparent/invisible we can make the boundaries of the library, and the more we can anticipate the user's needs and match our resources to them, the better off we are. Our job should not be to stand between the user and the information if there is a better way for him/her to gain access to what is needed. The role of the library in this scenario is to assist in the design of the system, to accumulate the electronic counterpart of the library that will support this curriculum, and to work with users in navigating the system. All of our traditional skills come into play—understanding the structure of information, acquiring and organizing information, and assisting users. They are simply transferred to a different arena.

This project has the potential to affect a cultural change within Columbia Health Sciences—to transform the way we think about education and how we engage each other regarding our responsibilities as teachers/educators. We have an opportunity to reassess our educational methodology and to make some fundamental changes. Conversely, we may confirm with resolve that change is not needed in some areas, but it will be a decision made knowingly, not by default. Finally, we hope to create a system that will stimulate the imagination of students as well as accommodate their intuition, and at the other end of the spectrum, one that will contribute to more effective and efficient delivery of health care education without compounding costs.