
A strategy for curriculum integration of information skills instruction

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The ever increasing need of health professionals for information and the inclusion of active learning experiences in the medical school curriculum require that students learn the effective use of health information tools. Curriculum integration is gaining acceptance as an effective approach to teaching information skills in this setting. At the University of Miami School of Medicine, information skills components taught by library faculty are integrated into the Freshman Orientation Program and two sophomore curriculum courses. Beginning with a core set of skills and basic information management tools, more complex and subject-specific skills are introduced sequentially throughout the basic sciences curriculum. During the first two years, a wide range of information skills are taught, and students receive many opportunities to seek and identify information using both printed sources and computerized bibliographic databases. This paper describes how curriculum integration of information skills instruction was achieved and the many benefits of this approach. Included are a description of the information skills components, evaluation data, and future plans.

INTRODUCTION

Information and problem-solving skills are gaining recognition as central learning skills for all medical school students, and increasing numbers are receiving instruction in and opportunities to use these skills [1]. "The increasing dependence of the medical profession on information tools requires that medical students learn their nature and effective use" [2]. The landmark report of the Project Panel on the General Professional Education of the Physician and College Preparation for Medicine (GPEP) specifically recommends that students be given multiple opportunities to apply a wide array of basic information han-

dling tools and more complex computer systems in a wide variety of contexts. It also recommends that educational experiences be offered that "require students to be active independent learners and problem solvers, rather than passive recipients of information" [3].

There is growing acceptance that an effective educational approach to teaching information skills is to integrate instruction into the existing curriculum of the school, as opposed to creating separate courses [4-6]. Curriculum integration of information and other learning skills is already in place or a goal at most of the nation's colleges and universities. In the recent literature on bibliographic instruction, there is ample

documentation that curriculum integration enhances learning of the information skill being taught, the content of the primary curriculum course, and the cognitive skills that are generally considered to be central learning skills on the graduate level, i.e., concept learning, problem solving, and critical thinking. Integrating the teaching of information skills with the teaching of a primary curriculum course accomplishes two educational goals: learning information skills and acquiring information skills for learning [7-10].

Learning information skills

The curriculum integration approach enhances learning of information skills because it accommodates the basic tenets of skills instruction. It permits both the systematic and sequential development of information skills and the reinforcement of skills. Students can, for example, acquire a core set of skills and learn more complex and subject-specific skills as they progress through the curriculum. Skills presented in one course can be easily reviewed and reinforced in a later course. This approach allows an information skill to be presented at the student's time of need. This increases the students' motivation and learning by enhancing their acceptance and internalization of the need for proficiency in the skill.

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With curriculum integration, information seeking can be taught as a thinking process, with less emphasis on the tools or results of the search. The presentation of an information skill can be based on broad individual parameters. This is important since the ability to learn a skill is critically related to broad individual talents. This approach also permits the largest review possible of the biomedical literature in the widest array of contexts.

Acquired information skills for learning

In addition to enhanced learning of information skills, curriculum integration also aids cognition, permitting active learning of concepts embedded in the discipline's course content, as well as an appreciation of the discipline's complexity. In finding information on a concept, active learning of the concept occurs; in selecting a concept within a discipline, the complexity of the discipline is appreciated. This approach enhances active learning of important cognitive skills,

such as problem-solving techniques, critical and analytical thinking, and oral and written skills. In finding information on a concept, students learn information skills appropriate to a discipline and how to use them as problem-solving strategies. In reviewing and synthesizing the literature retrieved, students use and develop their critical and analytical skills; in writing and presenting a paper on the concept, their communication skills are used and developed.

Other benefits

There are additional benefits of curriculum integration of information skills instruction when library faculty are largely responsible for designing and achieving the information skills objectives of content courses. This permits the broadest possible range of instruction on information tools with the least possible strain on the existing curriculum and teaching load of primary course faculty, the most effective method of relating information skills instruction to content assignments in curriculum courses, a multidisciplinary approach to both courses and instructional aids such as videotapes, the coordination of information skills components throughout the curriculum, and the establishment of the library as an integral part of the school's educational program.

Obstacles

With the many benefits of this approach for the student, primary course faculty, and the library, why is curriculum integration of information skills instruction not yet in place throughout the nation's four-year medical school programs? There are five broad obstacles to implementing this approach.

- Faculty resist changing long used teaching methodologies, such as the didactic lecture.
- Faculty are frequently unable to understand what librarians can contribute to the educational process beyond procuring and managing the materials needed for instruction.
- Medical school administrators may not be supportive of this approach and may fail to assign departmental responsibility and authority for the educational program in medical information sciences.
- Library faculty and administrators may not be sufficiently knowledgeable about effective educational techniques and/or the medical school curriculum.
- Library faculty and administrators may not be sufficiently involved in the school's curriculum committee and other arenas for educational change.

This paper describes the strategy adopted by the Louis Calder Memorial Library of the University of Miami School of Medicine to achieve curriculum integration of information skills instruction, the infor-

mation skills components currently in place, an evaluation of these components, and future plans.

PROGRAM DEVELOPMENT

In 1986 a primary course faculty member in the Department of Oncology of the University of Miami School of Medicine joined the faculty of the Louis Calder Memorial Library as an adjunct associate professor. He shared the library faculty's interest in expanding and improving the teaching of information skills at the school. At the time, a one-hour lecture on basic information management tools was given to approximately 150 entering freshmen by a library faculty member in a classroom setting. During a series of meetings, it was agreed that information skills instruction should be improved, by making it as active as possible, and expanded, by integrating it into the existing medical school curriculum.

The primary course and library faculty decided on the following method of implementing their decision. As a first step, the existing curriculum was analyzed to determine which courses had a problem-solving assignment requiring bibliographic work, such as a research paper, and which courses were taught by faculty who were responsive to recommendations in the *GPEP Report* and supportive of the library. The analysis focused on the first two years of the curriculum. Many of the recent curriculum changes in response to the *GPEP Report* had occurred in the basic science courses. Since information skills are needed throughout, they should be presented as early in the curriculum as possible.

Three courses were targeted for integrating information skills: "Health and Human Values," given in the first semester of the freshman year; "Pathology," given in the first semester of the sophomore year; and "Mechanisms of Disease," a second semester, sophomore-year course. For the "Health and Human Values" course, students are required to select a topic on aging as part of the life cycle or the physician-patient relationship and find, analyze, and communicate in writing information on the topic selected. Students are required to work through three computer-assisted instruction programs for the "Pathology" course. They are required to select topics for the gerontology and oncology segments of the "Mechanisms of Disease" course and find, summarize, and communicate information on the topic orally and in writing.

Since an information skill is best presented at the student's time of need, the one-hour lecture to entering freshman was redesigned to include the basic skills needed by students and appropriate to the assignment of the first semester "Health and Human Values" course. The lecture format was replaced with an interactive, large-group session and supplemented

Figure 1
Information skills components

FRESHMAN YEAR
Core Skills
First freshman semester "Health and Human Values" course
Interactive, large-group session
Self-paced audiotape tour of library
Self-paced library exercise
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SOPHOMORE YEAR
Computer Skills
First sophomore semester "Pathology" course
Small-group, computer-assisted instruction programs
Second sophomore semester "Mechanisms of Disease" course
Large-group demonstration/instruction
Self-paced computer searches

with self-instructional programs and exercises. The primary course faculty member secured the additional one-half hour needed for the revised sessions from the deputy dean for medical education who administers the week-long Freshman Orientation Program. An information skills component was created for the second semester of the sophomore year "Mechanisms of Disease" course in which some of the skills introduced during the freshman orientation were reinforced and others, more complex and appropriate to the content of the course, were introduced.

The lecture format was replaced with an interactive, large-group session and supplemented with self-instructional programs and exercises.

The primary course faculty member, who teaches the oncology and gerontology segments of the "Mechanisms of Disease" course, secured approval from the school's Curriculum Committee to incorporate an information skills component and implement a small-group structure in these segments. This method of integrating information skills instruction into the medical school curriculum was successful in part because it bypassed obstacles previously enumerated. Information skills components taught by library faculty are now supported by the Curriculum Committee, primary course faculty leaders, and medical school administrators. There is growing acceptance of additional components being taught by library faculty throughout the curriculum.

PROGRAM DESCRIPTION

The three information skills components currently in place appear in Figure 1.

Core skills

The revised freshman orientation information skill component, titled "Introduction to the Medical Literature," has six learning objectives: locate background information and bibliographies in standard medical and specialty texts, locate review articles and recent references on a subject in *Index Medicus*, execute search strategies using the citation section of *Science Citation Index*, identify information needs that may require a MEDLINE search, locate brief descriptions and key references on specific diseases, and locate materials in the library and understand the library's policies and procedures. This core skills component has three parts: an interactive, large-group session, a walking audiotope tour of the library, and a self-paced exercise.

The 1.5-hour, large-group session begins with a welcome from primary course and library faculty. A library faculty member then administers a pretest, called a pre-orientation assessment, to the entering freshman class. Part one tests knowledge of the organization of biomedical information; part two tests knowledge of retrieval strategies appropriate to the biomedical literature. The pretest is collected and students receive new copies for the subsequent review of the questions. A twelve-minute videotape, *The Anatomy of Biomedical Information* [11], presents the correct information to part one of the pretest by integrating information on the organization of biomedical information with clinical sequences. A medical student is seen at the bedside, reviewing the patient history and diagnostic findings with a primary course faculty member, and in the library identifying and finding needed information for the case. The subject and citation approaches to biomedical information are then presented by library faculty. The primary course faculty member reviews part one of the pretest with group responses following the tape. A library faculty member reviews part two in an interactive session with slides and handouts on basic information management tools for retrieving information using AIDS as an example. The tools include dictionaries, textbooks, videotapes, *Medical Subject Headings* (MeSH), *Index Medicus*, *Science Citation Index*, and drug directories. AIDS was selected as the example for part two because it is more or less familiar to entering freshmen and an excellent topic for teaching the timeliness and variety of sources of biomedical information and the controlled vocabulary system, MeSH.

During the two weeks following the large-group session, all freshmen are required to take a walking audiotope tour of the library, which explains the location, policies, and procedures of its resources and services, and complete a self-paced exercise using the basic information tools included in the large group

session to solve predefined information problems. When students sign up for the audiotope tour, they receive a Walkman cassette player, an information packet with the library's floor plan, policies and procedures, and one of the six versions of the library exercise created to reduce copying. Each of the exercises requires students to give the source and define a syndrome, identify the correct MeSH heading for a concept, and find articles in *Index Medicus* and *Science Citation Index*.

The core information skills taught during the orientation component are necessary for and appropriate to the content of the "Health and Human Values" course. Since this first semester course is psychosocial and not clinical in nature, database searching skills were intentionally omitted from the orientation component.

Computer skills

During the sophomore year, all students receive instruction in accessing nonprint and computerized sources of information and opportunities to actively learn the content of the "Pathology" and "Mechanisms of Disease" courses from these sources. During the first sophomore semester, students are required to work through three interactive videodisc programs in the library's Learning Resources Center [12-14]. The opportunity to use a personal computer and interactive software to learn independently the content of a course is accorded all students. These programs are well received by the students and, together with the information skills component of the freshman-year course, prepare students for accessing the MEDLINE database in the Microcomputer Lab of the library's Learning Resources Center.

The information skills component of the second sophomore semester is integrated into the gerontology and oncology segments of the "Mechanisms of Disease" course and has eight learning objectives: review MeSH terms and subheadings, review the indexing specificity rule and the scope of *Index Medicus*, understand the relationship between *Index Medicus* and the MEDLINE databases, learn the Boolean logical operators used in computerized bibliographic searching, learn searching techniques appropriate to gerontology and oncology, perform a successful search in these disciplines, analyze and communicate information retrieved on a concept within these disciplines to a small group, and develop and give a quiz to the small group on the information presented. Since the clinical focus of the oncology and gerontology segments is well supported by MeSH and MEDLINE, these segments were targeted for introducing database searching skills.

The second class day of the second semester is an interactive, large-group session with the sophomore

class. Searching the MEDLINE database is the subject. A library faculty member begins the session with a review of MeSH and *Index Medicus*, presented during the freshman orientation, "Introduction to the Medical Literature." The printed *Index Medicus*, used by all students on several occasions during the freshman year, is related to its database counterpart. The basic concepts of Boolean logic and the Boolean operators AND and OR are presented and illustrated. Several online searches of MEDLINE from PaperChase, Inc. are performed and projected on a large screen. The basic commands and features of searching MEDLINE from PaperChase, Inc. are demonstrated and reviewed. A handout is disseminated with the information presented during the session and a sample search.

Students receive instructions for registering for a one-hour search session in the library's Microcomputer Lab to identify literature on the concept of their choice for the gerontology and oncology segments of the course. Four one-hour sessions are available each week throughout the semester when students are not in class. During the search session, library faculty review the Boolean operators, students select a specific topic and, in groups of two students for each library faculty member, conduct a search using the PaperChase system. A password with \$20 of search time is preassigned by library faculty for each student. PaperChase matches the \$10 per password paid by the library and all additional charges for searches initiated before the \$20 allocation is reached. Students are encouraged to use up all their "free time" on MEDLINE, either during the one-hour session or at a later time. Students turn in the printout of their search along with the paper and a quiz each student writes and presents to a small group with a primary course faculty leader. Although three papers and presentations are required for the gerontology and oncology segments, a computer search is required for only one.

PaperChase, Inc. was selected for this information skills component in 1987. At the time, it was the only vendor of the MEDLINE database, known to the authors, that prompted the searcher to use MeSH headings and subheadings, as well as other features deemed appropriate to student searching: menu-driven search software, fully interactive search sessions, and a matching program for the online costs of searching.

PROGRAM EVALUATION

Core skills

The graded 150 pretests given during the freshman information skills component for each of two consecutive years indicated that seven (33%) of the questions were answered incorrectly by 50% or more of the entering freshman classes. This level of incorrect

responses validated the need to teach core biomedical information skills to the freshman. This need, documented by Kolner et al. [2], was also substantiated by comments on the evaluation forms for the large-group session.

The effectiveness and student acceptance of the core skills component can be seen from the evaluation forms and graded exercises. On a scale of "1" to "5", 115 (94%) of students rated the large-group session "5" ("excellent") or "4" ("good"). Of the six information problems on the library exercises, an average of 5.5 were answered correctly on the 139 completed exercises turned in. Since six different versions of the exercise were used, the level of copying answers is presumed to be minimal. Evaluations of the library exercises revealed that on a scale of "1" to "5" ("extremely easy" to "extremely difficult"), seventy-four (55%) of students rated the exercises a "3". Follow-up with the primary faculty for the "Health and Human Values" course revealed that students had few problems finding information needed for the research paper required for the course.

Computer skills

An examination of the MEDLINE printouts, turned in by students with their papers for the "Mechanisms of Disease" course, revealed that the learning objectives of the information skills components for this course had been accomplished. Every student began the search by ANDing two or more specific MeSH terms. Since the MEDLINE database on PaperChase consists of more than five million citations to articles published from 1966 to the present in one file, all students limited the results of ANDing MeSH terms by at least one, and in some cases, four of the following five ways: attaching subheadings to the MeSH headings to narrow the scope of the concept represented by the MeSH heading; weighting MeSH headings to restrict the citations retrieved to those where the main focus of the article being cited is represented by the MeSH heading used in the search; ANDing "English" to eliminate the many MEDLINE citations to articles written in other languages; ANDing a range of years, e.g., 1984-1988, to narrow the retrieval to the most recent citations; and ANDing "Review" to narrow the citations retrieved to those articles which are comprehensive in scope, as opposed to a case report for example, on the subject being searched. With these strategies, 98% of the printouts were restricted to fifty or fewer recent, English language citations on a specific topic in gerontology or oncology.

As can be seen from Table 1, an analysis of the student evaluations of the MEDLINE skills component revealed that on a scale of "1" to "5" ("not helpful" to "extremely useful"), seventy (64%) of responses rated the component "4" or "5" in terms of

Table 1
Computer skills evaluation data

	Not helpful 1	2	3	4	Extremely useful 5
*Overall impact	6 (6%)	7 (6%)	26 (24%)	34 (31%)	36 (33%)
†Self-paced search sessions	8 (7%)	13 (11%)	29 (26%)	28 (25%)	35 (31%)

* n = 108

† n = 113

overall impact. Ratings for the microcomputer lab session were similar. The high degree of acceptability and usefulness of the component reflected by these numerical ratings was also reflected in student comments. The most frequent comment was "helpful" or "very valuable." The only other frequent comment was "too time-consuming" or "require only one paper."

Another indication of student acceptance of the searching skills component was the number of students who did more than the one computer search required. On the evaluation forms, students were asked to give the method employed to retrieve literature for each of the three required papers. Of the respondees to this question, thirty-four (45%) students who signed up for the required search session for the first or second paper did another search for the second or third paper voluntarily. Sixteen (21%) of these students did computer searches for all three papers. Students were also asked to describe their previous experience doing their own searches. Ninety-four (90%) students responding to this question had never or rarely done a search before. At least twenty-four (26%) students with little or no previous experience showed a behavior change, perhaps the true indication of effective learning, by electing to do a second or third search instead of using printed indexes or textbooks.

SUMMARY AND FUTURE PLANS

Integrating information skills instruction into content courses in the medical school curriculum and designing active learning opportunities for this instruction are effective and efficient approaches to implementing many of the learning and information skills recommendations of the *GPEP Report*. Through these approaches, students learn to apply basic information handling tools and more complex computer systems in a variety of contexts. They learn to use information skills as problem-solving techniques for both predefined problems and problems of their own definition with the least possible strain on the existing curriculum. They use problem-solving tech-

niques that are specific and appropriate to a discipline and experience active, independent learning of the content of a course. Information skills are developed both systematically and sequentially. Basic skills presented in the freshman year are reinforced and linked to new and more complex skills in the sophomore year. Information skills are presented and used at the student's time of need, which enhances learning of the skills.

These approaches also provide opportunities for learning valuable cognitive skills, such as concept learning, problem solving, and critical thinking. In the process of selecting a concept within a discipline, students learn the complexity of the discipline. Particularly when the selected concept is on the leading edge of the discipline or is controversial, critical and analytical thinking is required. Formulating a search strategy for a bibliographic database is an excellent opportunity for using and developing cognitive skills. Computerized information retrieval also reduces the tedium of literature searching, forces students to delineate the topic, and encourages them to spend more time organizing and communicating the information retrieved [15].

Basic skills presented in the freshman year are reinforced and linked to new and more complex skills in the sophomore year.

The information skills component taught by library faculty establishes the library as an integral part of the school's educational program. Primary course faculty become more familiar with library resources and information skills and library faculty with the curriculum and needs of the students. As a result, information skills are effectively related to the content assignments of the curriculum courses. A multidisciplinary approach to both courses and instructional aids, such as videotapes, is aided and insured.

With only one hour of large-group demonstrations and handouts, most students need active assistance from faculty when conducting their first search. The almost routine ANDing of a range of years to restrict search retrieval indicates that searching the entire MEDLINE file is unnecessary. Limiting searches to the recent four- or five-year segment of the MEDLINE database, or to a subset of journals within the database, would be highly desirable for the "Mechanisms of Disease" course. PaperChase and other sources of MEDLINE via dial-up/remote access incur charges that can be an obstacle to subsequent searching and use of newly acquired skills. The recent proliferation of CD-ROM versions of MEDLINE will eliminate the

restrictions imposed by online and database access charges for the information skills components. The availability of CD-ROM versions of current MEDLINE subsets and the capability of networking them in microcomputer labs will further the use of this technology for information skills components.

In addition to change occasioned by technological advances, changes in primary courses will ensure change in their information skills components. A re-vamping of the entire "Mechanisms of Diseases" course, for example, is currently underway. The re-vamping is due in part to the more general recognition among faculty and administrators of the importance of developing cognitive skills during the medical school curriculum. It is anticipated that the subsequent evolution of the computer skills component will continue to address the many advantages of information skills for learning.

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REFERENCES

1. REIDELBACH MA, WILLIS DB, KONECKY JL, RASMUSSEN RJ. An introduction to independent learning skills for incoming medical students. *Bull Med Libr Assoc* 1988 Apr;76(2):159-63.
2. KOLNER SJ, DALRYMPLE PW, CHRISTIANSEN R. Teaching skills in medical information retrieval to medical students. *J Med Educ* 1986 Nov;61(11):906-10.
3. Physicians for the Twenty-First Century. Report of the Project Panel on the General Professional Education of the Physician and College Preparation for Medicine. *J Med Educ* 1984 Nov;59(11 Part 2):1-208:12.
4. MUELLER MH, FOREMAN G. Library instruction for medical students during a curriculum elective. *Bull Med Libr Assoc* 1987 Jul;75(3):253-56.
5. GRAVES KJ, SELIG SA. Library instruction for medical students. *Bull Med Libr Assoc* 1986 Apr;74(2):126-30.
6. ALLEGRI F. Course integrated instruction: metamorphosis for the twenty-first century. *Med Ref Serv Q* 1985/86 Winter;4(4):47-66.
7. OBERMAN C, STRAUCH K, eds. Theories of bibliographic education: designs for teaching. New York: Bowker, 1982.
8. AFFLECK D. A curriculum-integrated bibliographic instruction program at the academic level. *Educ Libr Bull* 1986 Summer;29(2):37-48.
9. ARP LL, WILSON LA. Library instructor's view—theoretical. *Res Strat* 1984 Winter;2(1):16-22.
10. KOBELSKI P, REICHEL M. Conceptual frameworks for bibliographic instruction. *J Acad Libr* 1981 May;7(2):73-7.
11. LOVE N, BURROWS S. The anatomy of biomedical information. Miami, FL: University of Miami School of Medicine, 1985. [Videotape]
12. JONES RR. Cellular alterations and adaptations. Bethesda, MD: Lister Hill National Center for Biomedical Communications, 1982. [Videodisk]
13. JONES RR, WOODS JW. Cell injury. Bethesda, MD: Lister Hill National Center for Biomedical Communications, 1982. [Videodisk]
14. DEPENA M, LOVE N. Pandora's box: a computer assisted video program on basic pathology. Miami, FL: University of Miami School of Medicine, 1987. [Videodisk]
15. DANIELS CE. Online information retrieval: an under-utilized educational tool. *Info Serv Use* 1984 Aug;4(4):229-43.

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