Surveying knowledge and skills in the health sciences: results and implications

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The MLA Knowledge and Skills Task Force was appointed in May 1989. The task force decided to survey a sample of the membership to define the knowledge and skills required for competent professional performance and to enable MLA to establish educational policies which would ensure acquisition and maintenance of the necessary knowledge and skills throughout a professional career. This report presents the initial findings of the survey, upon which MLA's educational policy statement, Platform for Change, is based.

At the heart of many of the present problems facing librarians and library education is the failure to describe the profession and its present role in terms that are compelling, expansive and accurate. The principles, the responsibilities, and the body of knowledge that shape the profession are real and of great importance ... but they are either largely implicit or incompletely formed and are certainly not widely understood [1].

INTRODUCTION

In May of 1989, the Medical Library Association (MLA) Knowledge and Skills Task Force was appointed in response to a number of different initiatives. The primary impetus was MLA's own strategic plan, which spelled out the strategy of influencing curricula of academic institutions in the areas of design, development, and management of information systems. To implement this strategy, it seemed necessary first to validate what it is that health information professionals do and then to determine what knowledge and skills would be needed in the future. A second impetus, closely related to the first, was the revision then underway of the American Library Association (ALA) standards for accreditation of master's programs in library and information science. As a part of that revision process, each of the major library and information science associations was asked to provide the Committee on Accreditation with educational and other policy statements pertinent to the needs of that

organization so that they could be shared with educators.

The task force (Appendix A) decided to survey a sample of the membership with two goals in mind: to define the knowledge and skills required for competent professional performance now and in the future and to enable MLA to establish educational policies which would ensure the acquisition and maintenance of the necessary knowledge and skills throughout a professional career. When tabulated and analyzed, these data would provide an inventory of knowledge and skills described in two major ways: scope (i.e., what are these skills?) and setting (i.e., where is the learning most likely to occur and be applied?).

In January 1990, a grant application was submitted to the Council on Library Resources seeking assistance in funding this survey and some related activities. The task force received a grant of slightly more than $9,300.00. Additional funding was available from MLA and the University of South Carolina.

This report presents the initial findings of the survey. MLA's educational policy statement, Platform for Change, was based on the survey. Adopted by the MLA Board of Directors in December 1991, the document describes the need for lifelong, interdisciplinary learning. It suggests that health care information will continue to expand exponentially and that health care will be one of the nation's most critical information issues. The document also provides concrete

guidelines for graduate programs and insists on a strong continuing education role by MLA and the National Library of Medicine (NLM).

The philosophy of *Platform for Change* is perhaps best demonstrated in the quotation of medical librarian Estelle Brodman:

We must educate for the problems of a generation hence, not for the problems of today . . . librarians must be imbued with the psychological ability to handle change and to live with ambiguity. Without this they will be performing tomorrow's tasks with yesterday's concepts [2].

RELATED LITERATURE

As society has moved more firmly into the information age, the need for specialists with a clear understanding of the many facets of the information process and the technical skills to support that process has become apparent.

In their 1982 report, *Academic Information in the Academic Health Sciences Center: Roles for the Library in Information Management*, Nina Matheson and John A. D. Cooper assert that technological advances not only improve efficiency and allow for new approaches to tasks but also transform both the library and the role of the professional manager of biomedical information resources, with a concomitant requirement for new skills and knowledge among health information practitioners [3]. Recent reports of the Panel on the General Professional Education of the Physician (GPEP), *Physicians for the Twenty-first Century* [4], and the *NLM Long Range Plan* [5], as well as the proceedings of the 1986 symposium on medical informatics, *Medical Education in the Information Age* [6], underscore the need for new skills in information processing, biomedical subject knowledge, consumer service, and education. They also assert that new models for professional education are essential to address changes in the social and technological environment of the future.

Similarly, MLA documents have focused attention on issues in education. A 1979 article by one of the present authors described a critical role for graduate education in the preparation of health sciences information professionals [7]. In 1981, the report of the Study Group on MLA's Role in the Educational Process for Health Sciences Librarians called upon the association to reassess education needs for a changing environment, drawing particular attention to alternative pathways into the profession [8]. The MLA *Ad Hoc* Committee on Professional Development followed in 1984 with strong recommendations that the association work closely with graduate schools of library and information science to develop curricula incorporating the essential knowledge and skills [9]. *Shaping the Future*, MLA's 1987 strategic plan, further

acknowledged the need to define the knowledge and skills needed by the field [10]. In 1988, MLA endorsed a new program of credentialing, the Academy of Health Information Professionals. Qualifications for the academy include documented competence in ten areas of essential knowledge:

- health care environment;
- medical concepts and terminology;
- information needs of health professionals;
- computer hardware, software, and information-related applications;
- basic research techniques;
- basic management principles;
- acquiring and organizing information;
- medical subject heading (MeSH) and NLM classification;
- information sources in the health sciences; and
- online searching, including MEDLINE [11].

The MLA curriculum for continuing education reflects a commitment to those areas as well.

Kent Mayfield [12–13], Rachael Anderson [14], and Judith Messerle [15] have emphasized the need for a new coalition of expertise and resources within the profession to define the skills and competencies needed for professional practice and to support their acquisition in graduate school and beyond. However, the literature provides little research to support recommendations regarding what knowledge and skills are required to function in the environment so compellingly described by leading information professionals, the GPEP studies, and the several MLA reports.

THE TASK FORCE: RESPONDING TO THE CHALLENGE

The 1989 revision of *Shaping the Future*, the MLA strategic plan, identified several key strategies intended to position the association as a leader in education for the design, development, and management of information systems and for the creation and provision of information services, as well as education for health information users [16–17]. These strategies involved identifying the knowledge and skills necessary for professional performance in these areas and influencing curricula and accreditation of academic programs for health sciences librarians and information specialists.

As a first step in implementing these strategies, MLA established the Task Force on Knowledge and Skills, which focused on two goals: to define the knowledge and skills required for competent professional performance now and in the future, and to provide MLA with an educational policy statement that would influence the curricular and accreditation of relevant academic programs and ensure the ac-

quisition and maintenance of knowledge and skill throughout a professional career.

A survey of medical librarians was proposed, the results of which, when tabulated and analyzed, would provide an inventory of knowledge and skills described by both scope—what these skills are—and by setting—where the learning is most likely to occur and where the learning is most likely to be applied. Furthermore, the survey conducted by the task force would remedy in part the lack of a research base for decision making and provide a foundation on which to develop a new consensus within the health sciences information community regarding the knowledge and skills required to meet the needs of health care, medicine, research, and education in technologically alert, user-driven, and rapidly changing organizational environments.

DESIGN OF THE STUDY

Objectives

The basic objective of the study was to gather data that would provide answers to the following questions.

■ To what extent do health sciences librarians consider identified areas of knowledge and skill important to effective professional performance in the environment of the future?

■ To what extent do health sciences librarians perceive that they now possess these skills?

■ Where do health sciences librarians tend to acquire knowledge in these areas?

■ Where do health sciences librarians think such knowledge is best acquired?

In addition to answering these questions, the study was designed to explore possible relationships between the answers and the respondent's institutional setting, level of responsibility, and years of experience in the field. This paper summarizes the analysis completed to date.

Population

A sample of 750 health sciences librarians was chosen from the MLA membership database. For the purposes of this study, health sciences librarians were defined as practicing librarians or students enrolled in programs of study leading to careers in health sciences librarianship. The population was limited further to include only librarians or students in the United States and Canada. The study population was not stratified by educational background, duration of experience, or level of job responsibility. It was, however, stratified by geographical area and institutional setting, as identified in the MLA membership database.

Data collection

A four-section survey instrument was designed to gather the data needed to answer the major research questions. The first two sections of the questionnaire consisted of twelve questions requesting information about current position, institutional affiliation, primary area of responsibility, education, and assessment of educational activities.

The third section was presented in a matrix format. Respondents were asked to provide various information on sixty-three knowledge bases identified in an expert review of the literature in health sciences librarianship. The knowledge bases represented the following seven broad areas: health sciences environment and information policies; health sciences information services; health sciences resource management; information systems and technology; management of information services; instructional support systems; and research, analysis, and interpretation.

Although it was a formidable task for study participants to respond to so many questions, the authors concluded that such specificity was needed to generate meaningful, useful data.

Demographic information on each participant was gathered in section 4 of the survey instrument.

Following a pretest, copies of the survey questionnaire were mailed to 750 health sciences librarians. A total of 375 usable questionnaires, representing 50% of the sample population, were returned. Eighty-eight percent of respondents were employed full-time, 12% part-time. Thirty-nine percent were employed in academic health sciences libraries, 33% in hospital libraries, and the rest in commercial, government, and other types of libraries. Most were female (88%).

A "graying" of the field was evident in the age and years of experience measures. Sixty-seven percent of the respondents were forty or older. Forty-nine percent had more than fifteen years of experience in the field. Forty-four percent have spent five or fewer years in their present positions.

Preliminary expert review

Health sciences librarians are not alone in considering the knowledge and skills required both to maintain and to improve the management of biomedical information in coming years. The knowledge explosion occurring in medicine and the basic biomedical sciences, coupled with new developments in health care management, dictates that physicians, students, researchers, health care administrators, and consumers learn to use new strategies for managing information and knowledge. Medical information sciences, computers, and a growing understanding of the processes of clinical decision making may be key

factors in information management and analysis in the years ahead.

The authors thought it essential, therefore, to give experts from medicine, health care, and librarianship an opportunity to review and comment upon the preliminary survey results. Of special concern was the degree to which health sciences information professionals paralleled their expectations and the points of critical difference. Formal discussions were scheduled with key figures in medicine and health care administration in Washington, Los Angeles, Boston, Denver, Phoenix, and Chicago. Leaders in library and information science also were interviewed. While a number of issues were raised for further investigation, these discussions confirmed that the findings and recommendations of this study provide a sound base from which to develop a new consensus for the educational preparation of health information professionals.

SURVEY RESULTS

Knowledge and skills: importance

For each of the sixty-three knowledge bases, respondents were asked to indicate how important each was for effective performance in their current positions, how important it was to effective performance in the health information profession now, and how important it would be in the future. The importance of each element of knowledge or skill was measured on a five-point scale. The results are presented in Table 1.

Although traditional areas of knowledge and skill tended to rank relatively high in importance to the profession now, the top two areas of knowledge and skill are drawn from the nontraditional areas of management and health sciences environment. Oral and written communication skills ranked well above knowledge of health sciences practitioners' needs and of health sciences information resources. However, among the top twenty most important areas of knowledge and skills were nine drawn from the traditional areas of public services and technical services, including retrieval techniques, selection of information, development of services for information needs, bibliographic tools, methods of information delivery, resource sharing, information needs assessment, evaluation and synthesis of information, and the identification of materials and sources. In addition to oral and written communication skills, ranked among the top ten were three other elements of knowledge and skills related to management: planning, budgeting, and interpersonal relations. Other management-related knowledge and skills in the top twenty were public relations and marketing and personnel management. Only two citations in the top twenty referred to information systems and technology: computer software was ranked ninth; telecommunications

and networking was matched with information needs assessment at 15.5.

Although there is consistency between skills ranked high in terms of importance to the profession and those ranked among the top twenty in importance to the respondents' present position, two skills are notable for the inconsistency. Budgeting and personnel management are ranked only twenty-fifth and twenty-sixth respectively, in terms of importance to the respondents' present position. Of the top ten skills for present position, two were ranked lower for the profession at large: methods of information delivery and information needs assessment. Three skills not noted in the top twenty of importance to the profession are found on the list of those most important to present post: NLM programs and policies (ranked 17), organizational behavior (ranked 18), and services and project management (ranked 19.5).

There is a fairly high level of correlation between the level of importance of each of the knowledge bases "now" and "in the future." In particular, one area of knowledge or skill not among the top twenty for the present was cited on that list for the future: computer hardware. Other notable differences included the following: telecommunications and networking, ranked 15.5 for the present and 6.5 for the future; selection of information resources, ranked 5 for the present, falls to 13.5 for the future; interpersonal relations, ranked 8 for the present, slips to 17 for the future; and bibliographic tools, ranked 11 for the present, drops to 20.5 for the future.

Knowledge and skills: amount held

Respondents also were asked to assess the amount of knowledge or skill currently held for each of the sixty-three knowledge bases. The amount of each area of knowledge or skill was measured on a four-point scale. The results are present in Table 2.

Of the top twenty areas of knowledge and skills ranked according to amount held, four were considered of less importance to the profession now (NLM programs and policies, serial publications, professional library associations, and formats of information). For the future, that discrepancy remains consistent, with the addition of two more knowledge bases: bibliographic tools and identification of materials and sources.

Among the top ten elements of knowledge and skills held, four (bibliographic tools, methods of information delivery, health sciences environment, and identification of materials) are ranked below that level of importance for the profession now; three (bibliographic tools, health sciences environment, and identification of materials) below that level of importance to the present position; and four (bibliographic tools, selection of information resources, in-

Table 1
Now versus present position and twenty-first century*†

Knowledge base	Importance now		Present position		Twenty-first century	
	Mean	Rank	Mean	Rank	Mean	Rank
Oral and written communication	3.75	1.0	3.67	1.0	3.80	1.0
Health sciences practitioners' need	3.67	2.0	3.55	2.0	3.78	2.0
Health sciences information resources	3.66	3.0	3.46	4.0	3.66	4.0
Retrieval techniques	3.64	4.0	3.37	5.0	3.71	3.0
Selection of information resources	3.44	5.0	3.23	7.0	3.47	13.5
Planning	3.41	6.0	3.27	6.0	3.56	8.0
Budgeting	3.40	7.0	2.85	25.0	3.58	5.0
Interpersonal relations	3.38	8.0	3.47	3.0	3.42	17.0
Computer software	3.37	9.0	3.22	8.0	3.57	6.5
Development of services for information needs	3.36	10.0	3.13	13.0	3.48	11.5
Bibliographic tools	3.34	11.0	3.15	11.0	3.32	20.5
Methods of information delivery	3.33	12.0	3.18	9.0	3.49	9.5
Health sciences environment	3.32	13.0	3.12	14.0	3.49	9.5
Resource sharing	3.31	14.0	3.02	16.0	3.46	15.5
Information needs assessment	3.27	15.5	3.17	10.0	3.48	11.5
Telecommunications and networking	3.27	15.5	3.14	12.0	3.57	6.5
Public relations and marketing	3.25	17.0	2.95	21.0	3.47	13.5
Personnel management	3.22	18.0	2.84	26.0	3.34	19.0
Evaluation and synthesis of information	3.20	19.0	2.97	19.5	3.46	15.5
Identification of materials and sources	3.19	20.0	3.07	15.0	3.27	24.0
Staff development	3.18	21.0	2.87	24.0	3.29	22.0
Serial publications	3.14	22.0	2.91	22.0	3.16	30.5
National Library of Medicine programs and policies	3.12	23.5	3.01	17.0	3.24	25.0
Computer hardware	3.12	23.5	2.88	23.0	3.36	18.0
Services and project management	3.08	25.0	2.97	19.5	3.22	27.0
Interinstitutional relations	2.99	26.5	2.74	28.0	3.13	32.0
Organizational behavior	2.99	26.5	2.99	18.0	3.16	30.5
Program evaluation	2.98	28.0	2.78	27.0	3.19	29.0
Integrated library systems	2.94	29.0	2.54	32.0	3.32	20.5
Database construction	2.89	30.0	2.65	30.0	3.28	23.0
Space planning	2.84	31.0	2.52	33.0	3.01	35.0
Formats of information	2.83	32.0	2.66	29.0	3.05	34.0
Acquisitions	2.81	33.5	2.56	31.0	2.81	40.5
Institutionwide information management	2.81	33.5	2.49	34.5	3.23	26.0
Copyright	2.80	35.0	2.49	34.5	2.93	36.0
Human behavior and technology	2.71	36.0	2.47	36.5	3.07	33.0
Indexing, abstracting, and classification systems	2.70	37.0	2.39	38.0	2.79	42.0
Information systems—design, use, evaluation	2.69	38.0	2.24	40.0	3.20	28.0
Professional library associations	2.54	39.0	2.47	36.5	2.67	47.5
Quantitative techniques	2.53	40.0	2.28	39.0	2.77	43.0
National information policies	2.51	41.0	2.17	42.0	2.90	37.0
Resource preservation	2.46	42.0	1.75	52.0	2.84	38.0
Information structure, transfer, and processing	2.43	43.0	2.06	43.5	2.83	39.0
Application of research	2.41	44.0	2.06	43.5	2.81	40.5
Educational needs assessment	2.40	45.0	2.22	41.0	2.65	49.0
Evaluation of research	2.35	46.0	2.03	45.5	2.74	44.0
Cataloging and classification theory	2.31	47.5	1.90	49.0	2.28	60.0
Research methodology	2.31	47.5	1.95	48.0	2.67	47.5
Circulation systems	2.29	49.0	2.03	45.5	2.31	57.5
Fund-raising	2.26	50.0	1.28	61.0	2.71	45.0
Publishing industry	2.25	51.0	1.96	47.0	2.53	51.0
Teaching methodologies	2.21	52.0	1.87	50.0	2.50	52.0
National and international cataloging standards	2.20	53.0	1.66	55.0	2.36	56.0
Instructional design	2.15	54.0	1.70	54.0	2.42	53.0
Evaluation of learning outcomes	2.10	55.0	1.73	53.0	2.41	54.0
Systems analysis	2.08	56.0	1.59	56.0	2.55	50.0
Inventory control techniques	2.07	57.5	1.80	51.0	2.21	61.0
Curriculum development	2.07	57.5	1.52	58.0	2.39	55.0
Thesauri construction	2.02	59.0	1.50	59.0	2.30	59.0
Statistical theory	1.91	60.0	1.39	60.0	2.31	57.5
Artificial intelligence and expert systems	1.83	61.0	1.24	62.0	2.70	46.0
Bibliometric techniques	1.82	62.0	1.55	57.0	2.14	62.0
Computer programming	1.67	63.0	1.21	63.0	2.09	63.0

* 5 = essential; 4 = very important; 3 = important; 2 = little importance; and 1 = no importance.
† Table 1 presents a list of all sixty-three areas of knowledge and skills ranked by present importance to the profession. The first column shows the mean scores for the present importance of the knowledge or skill to the profession. The second column provides the ranking of each knowledge base from 1 (most important) to 63 (least important). The third and fourth columns similarly present the mean score and ranking for the importance of each area of knowledge or skill to the respondents' present positions. In columns 5 and 6, the mean score and ranking for the importance of each in the twenty-first century are provided.

Table 2
Amount held versus now, present position, and twenty-first century*†

| Knowledge base | Amount held | | Importance now | Present position | Twenty-first century |
	Mean	Rank	Rank	Rank	Rank
Oral and written communication	2.61	1.0	1.0	1.0	1.0
Health sciences information resources	2.55	2.0	3.0	4.0	4.0
Retrieval techniques	2.50	3.0	4.0	5.0	3.0
Health sciences practitioners' need	2.49	4.5	2.0	2.0	2.0
Bibliographic tools	2.49	4.5	11.0	11.0	20.5
Selection of information resources	2.40	6.0	5.0	7.0	13.5
Methods of information delivery	2.39	7.0	12.0	9.0	9.5
Health sciences environment	2.38	8.0	13.0	14.0	9.5
Interpersonal relations	2.36	9.0	8.0	3.0	17.0
Identification of materials and sources	2.34	10.0	20.0	15.0	24.0
Resource sharing	2.31	11.0	14.0	16.0	15.5
National Library of Medicine programs and policies	2.30	12.0	23.5	17.0	25.0
Serial publications	2.28	13.5	22.0	22.0	30.5
Professional library associations	2.28	13.5	39.0	36.5	47.5
Development of services for information needs	2.24	15.0	10.0	13.0	11.5
Evaluation and synthesis of information	2.20	16.0	19.0	19.5	15.5
Formats of information	2.15	17.0	32.0	29.0	34.0
Personnel management	2.14	18.0	18.0	26.0	19.0
Planning	2.13	19.0	6.0	6.0	8.0
Information needs assessment	2.11	20.0	15.5	10.0	11.5
Budgeting	2.07	21.5	7.0	25.0	5.0
Acquisitions	2.07	21.5	33.5	31.0	40.5
Staff development	2.06	23.0	21.0	24.0	22.0
Services and project management	2.05	24.0	25.0	19.5	27.0
Computer software	1.99	25.5	9.0	8.0	6.5
Copyright	1.99	25.5	35.0	34.5	36.0
Indexing, abstracting, and classification systems	1.97	27.0	37.0	38.0	42.0
Telecommunications and networking	1.95	28.0	15.5	12.0	6.5
Organizational behavior	1.92	29.0	26.5	18.0	30.5
Public relations and marketing	1.90	30.5	17.0	21.0	13.5
Interinstitutional relations	1.90	30.5	26.5	28.0	32.0
Program evaluation	1.87	32.0	28.0	27.0	29.0
Database construction	1.86	33.0	30.0	30.0	23.0
Space planning	1.83	34.0	31.0	33.0	35.0
Computer hardware	1.82	35.5	23.5	23.0	18.0
Integrated library systems	1.82	35.5	29.0	32.0	20.5
Cataloging and classification theory	1.81	37.0	47.5	49.0	60.0
Circulation systems	1.75	38.0	49.0	45.5	57.5
Human behavior and technology	1.72	39.5	36.0	36.5	33.0
National information policies	1.72	39.5	41.0	42.0	37.0
Publishing industry	1.59	41.0	51.0	47.0	51.0
Institutionwide information management	1.58	42.0	33.5	34.5	26.0
Quantitative techniques	1.50	43.0	40.0	39.0	43.0
Educational needs assessment	1.47	44.0	45.0	41.0	49.0
National and international cataloging standards	1.46	45.0	53.0	55.0	56.0
Teaching methodologies	1.44	46.0	52.0	50.0	52.0
Research methodology	1.43	47.0	47.5	48.0	47.5
Information systems—design, use, evaluation	1.41	48.5	38.0	40.0	28.0
Inventory control techniques	1.41	48.5	57.5	51.0	61.0
Application of research	1.40	50.0	44.0	43.5	40.5
Evaluation of research	1.37	50.0	46.0	45.5	44.0
Thesauri construction	1.36	52.0	59.0	59.0	59.0
Information structure, transfer, and processing	1.34	53.0	43.0	43.5	39.0
Resource preservation	1.31	54.0	42.0	52.0	38.0
Bibliometric techniques	1.25	55.0	62.0	57.0	62.0
Instructional design	1.24	56.0	54.0	54.0	53.0
Evaluation of learning outcomes	1.23	57.0	55.0	53.0	54.0
Curriculum development	1.21	58.0	57.5	58.0	55.0
Fund-raising	1.05	59.0	50.0	61.0	45.0
Statistical theory	1.04	60.0	60.0	60.0	57.5
Systems analysis	1.03	61.0	56.0	56.0	50.0
Computer programming	0.89	62.0	63.0	63.0	63.0
Artificial intelligence and expert systems	0.78	63.0	61.0	62.0	46.0

* 4 = extensive; 3 = moderate; 2 = slight; 1 = none.
† Table 2 provides a list of all sixty-three knowledge and skill items ranked by the amount of knowledge held by the recipient. The first column shows the mean scores for amount of knowledge held by respondents; the second gives the ranking for amount held, ranging from 1 (most important) to 63 (least important). The third, fourth, and fifth columns show rankings in terms of importance to profession now (column 3), present position (column 4) and in the twenty-first century (column 5).

Table 3
Correlations of importance of knowledge base in current job, with years of professional experience

Knowledge base	Signifi-cance	X² correlation
Publishing industry	.000	.2225
Staff development	.000	.2129
Quantitative techniques	.000	.2301
Budgeting	.000	.2570
Fund-raising	.000	.2669
Computer software	.001	−.2038
Program evaluation	.002	.1947
Personnel management	.003	.1827
Organizational behavior	.003	.1869
Space planning	.007	.1675
Services and project management	.008	.1639
Indexing, abstracting, and classification systems	.009	−.1611
Resource preservation	.012	.1553
Statistical theory	.015	.1513
National information policies	.021	.1437
Interinstitutional relations	.027	.1375
Planning	.036	.1301
Telecommunications and networking	.043	−.1257
Computer hardware	.061	−.1166
Interpersonal relations	.078	.1096
Cataloging and classification theory	.084	−.1076
Database record and file construction	.090	−.1055
Application of research	.099	.1028

terpersonal relations, identification of materials) below that level of importance for the twenty-first century. On the other hand, budgeting, computer software, telecommunications and networking, and

public relations and marketing all ranked twenty or higher in importance for the profession now, but none was ranked so high in terms of knowledge held. This holds true for the present position and for the twenty-first century, with the addition of computer hardware, ranked 35.5 in amount held but 18 in importance for the twenty-first century.

Of equal significance is the level of knowledge or skill claimed by the respondents for the sixty-three knowledge bases. On a scale of 4 (high) to 1 (low), the highest level of knowledge claimed is 2.61, not equal even to a moderate ranking. It cannot be assumed, therefore, that the participants tended to rank the knowledge bases in roughly the same order whether they were considering levels of importance or knowledge held. Nor can it be assumed that the knowledge held, regardless of its importance ranking, is extensive.

One early speculation of the researchers was that the assigned importance of current knowledge or skills would vary with the length of professional experience of the respondents. To determine which, if any, knowledge and skills were related significantly to years of professional experience, the two variables were cross-tabulated. The current importance ratings for several of the knowledge bases were found to be related significantly to years of professional experience. Table 3 lists all the knowledge bases for which current importance ratings were related to years of

Table 4
Where acquired, ranked by importance now; knowledge bases 3.0 and above

Knowledge base	Importance now		% where acquired					
	Mean	Rank	Library school	Other formal academic programs	Internship	Continuing education	On the job	Other
Oral and written communication	3.75	1	12.9	29.6	1.9	15.2	26.6	13.8
Health sciences practitioners' need	3.67	2	11.1	4.2	4.8	21.1	45.5	13.3
Health sciences information resources	3.66	3	21.1	3.4	5.1	26.6	35.2	8.5
Retrieval techniques	3.64	4	20.3	3.6	4.5	30.1	35.2	6.2
Selection of information resources	3.44	5	27.0	2.7	4.0	23.0	36.3	7.1
Planning	3.41	6	18.1	8.3	1.9	23.3	37.8	10.4
Budgeting	3.40	7	15.9	7.9	1.2	16.4	48.7	9.9
Interpersonal relations	3.38	8	8.8	12.6	2.5	21.6	37.7	16.8
Computer software	3.37	9	10.7	6.5	2.2	25.0	40.6	15.0
Development of services for information needs	3.36	10	18.4	2.6	3.4	21.9	44.4	9.3
Bibliographic tools	3.34	11	33.7	2.2	3.8	21.6	32.8	5.9
Methods of information delivery	3.33	12	22.8	3.0	4.0	21.6	40.2	8.4
Health sciences environment	3.32	13	9.8	7.7	4.4	21.1	44.7	12.4
Resource sharing	3.31	14	18.2	1.0	5.2	19.0	44.7	12.0
Information needs assessment	3.27	15.5	21.5	4.4	3.2	22.4	38.3	10.1
Telecommunications and networking	3.27	15.5	11.7	4.2	2.0	24.9	44.9	12.3
Public relations and marketing	3.25	17	11.0	10.8	0.9	27.3	36.3	13.7
Personnel management	3.22	18	14.4	10.3	1.3	25.0	38.8	10.3
Evaluation and synthesis of information	3.20	19	19.7	7.6	2.9	19.1	39.8	10.9
Identification of materials and sources	3.19	20	29.7	2.8	3.8	20.9	35.8	7.0
Staff development	3.18	21	9.2	9.0	1.6	23.6	43.6	13.0
Serial publications	3.14	22	27.7	1.6	4.4	15.5	42.1	8.7
National Library of Medicine programs and policies	3.12	23.5	13.2	1.3	4.3	27.4	37.3	16.4
Computer hardware	3.12	23.5	12.2	6.6	2.1	23.2	41.5	15.1
Services and project management	3.08	25	9.7	6.9	2.5	20.8	46.6	13.4

Table 5
Where acquired, ranked by importance in current position; knowledge bases 3.0 and above

| Knowledge base | Importance now | | % where acquired | | | | | |
	Mean	Rank	Library school	Other formal academic programs	Internship	Continuing education	On the job	Other
Oral and written communication	3.67	1	12.9	29.6	1.9	15.2	26.6	13.8
Health sciences practitioners' need	3.55	2	11.1	4.2	4.8	21.1	45.5	13.3
Interpersonal relations	3.47	3	8.8	12.6	2.5	21.6	37.7	16.8
Health sciences information resources	3.46	4	21.1	3.4	5.1	26.6	35.2	8.5
Retrieval techniques	3.37	5	20.3	3.6	4.5	30.1	35.2	6.2
Planning	3.27	6	18.1	8.3	1.9	23.3	37.8	10.4
Selection of information resources	3.23	7	27.0	2.7	4.0	23.0	36.3	7.1
Computer software	3.22	8	10.7	6.5	2.2	25.0	40.6	15.0
Methods of information delivery	3.18	9	22.8	3.0	4.0	21.6	40.2	8.4
Information needs assessment	3.17	10	21.5	4.4	3.2	22.4	38.3	10.1
Bibliographic tools	3.15	11	33.7	2.2	3.8	21.6	32.8	5.9
Telecommunications and networking	3.14	12	11.7	4.2	2.0	24.9	44.9	12.3
Development of services for information needs	3.13	13	18.4	2.6	3.4	21.9	44.4	9.3
Health sciences environment	3.12	14	9.8	7.7	4.4	21.1	44.7	12.4
Identification of materials and sources	3.07	15	29.7	2.8	3.8	20.9	35.8	7.0
Resource sharing	3.02	16	18.2	1.0	5.2	19.0	44.7	12.0
National Library of Medicine programs and policies	3.01	17	13.2	1.3	4.3	27.4	37.3	16.4

professional experience at the .10 level of significance or higher. The table provides the level of significance (X^2 values) and correlation coefficients to show the relative strength of the association, ranked in order of significance. In general, the relationships were not found to be strong; further analysis of experience effects was not done.

Knowledge and skills: where acquired

Survey participants were asked to report the sources of their knowledge and skills. Six response categories were provided: library school, other formal academic programs, internship, continuing education, on the job, and "other".

Tables 4, 5, and 6 summarize the data for knowledge and skills ranked among the most important (mean score of 3.0 and above, where 1 is least important and 5 most important) in each of three categories: importance to profession now, importance in present position, and importance in twenty-first century. Knowledge and skills are presented in order of ranked mean scores. Columns 1 and 2 provide the mean score and ranking for each area of knowledge and skill. Columns 3 through 8 present the actual numbers of respondents who selected a given source of knowledge and skill. (The number of responses can be greater than the number of repondents because many skills were acquired from more than one source.)

For the twenty-five knowledge bases cited as important to the profession now, a majority of knowledge and skills were acquired in continuing education and on the job. Sixty-one percent of the responses cited one or the other of these sources: continuing education, 22%; on the job, 39%. Only 18% of the

responses represent library school. In all knowledge and skill areas, on-the-job acquisition is clearly the most common source. In most areas of knowledge and skills, continuing education is a more regular source than library school. However, in areas of traditional librarianship, including selection of information resources, bibliographic tools, methods of information delivery, evaluation and synthesis of information, identification of materials and sources, and serial publications, library school remains a strong source of knowledge and skill.

When sources were plotted against either the listing of seventeen areas of knowledge or skills most important to current position or the list of thirty-five knowledge bases projected to be most important in the twenty-first century, a similar pattern of source ranking emerged. Again, in areas of traditional librarianship, library school is a strong source of knowledge and skill. However, on-the-job experience remains paramount.

Knowledge and skills: where best acquired

Respondents also were asked where knowledge and skill might best be acquired. Tables 7, 8, and 9 display the responses, organized according to the rankings of knowledge and skills in order of importance (3.0 and above) for each of the three categories: profession, current position, twenty-first century.

Once again, the majority of knowledge and skills important to the profession now were judged to best be acquired from one of three sources: on the job (27%), library school (26%), and continuing education (25%). In addition to their importance in traditional librarianship, library schools also are seen as a source

Table 6
Where acquired, ranked by importance in twenty-first century; knowledge bases 3.0 and above

Knowledge base	Importance Mean	Importance Rank	% where acquired Library school	Other formal academic programs	Internship	Continuing education	On the job	Other
Oral and written communication	3.80	1	12.9	29.6	1.9	15.2	26.6	13.8
Health sciences practitioners' need	3.78	2	11.1	4.2	4.8	21.1	45.5	13.3
Retrieval techniques	3.71	3	20.3	3.6	4.5	30.1	35.2	6.2
Health sciences information resources	3.66	4	21.1	3.4	5.1	26.6	35.2	8.5
Budgeting	3.58	5	15.9	7.9	1.2	16.4	48.7	9.9
Computer software	3.57	6.5	10.7	6.5	2.2	25.0	40.6	15.0
Telecommunications and networking	3.57	6.5	11.7	4.2	2.0	24.9	44.9	12.3
Planning	3.56	8	18.1	8.3	1.9	23.3	37.8	10.4
Methods of information delivery	3.49	9.5	22.8	3.0	4.0	21.6	40.2	8.4
Health sciences environment	3.49	9.5	9.8	7.7	4.4	21.1	44.7	12.4
Information needs assessment	3.48	11.5	21.5	4.4	3.2	22.4	38.3	10.1
Development of services for information needs	3.48	11.5	18.4	2.6	3.4	21.9	44.4	9.3
Selection of information resources	3.47	13.5	27.0	2.7	4.0	23.0	36.3	7.1
Public relations and marketing	3.47	13.5	11.0	10.8	0.9	27.3	36.3	13.7
Resource sharing	3.46	15.5	18.2	1.0	5.2	19.0	44.7	12.0
Evaluation and synthesis of information	3.46	15.5	19.7	7.6	2.9	19.1	39.8	10.9
Interpersonal relations	3.42	17	8.8	12.6	2.5	21.6	37.7	16.8
Computer hardware	3.36	18	12.2	6.6	2.1	23.2	41.5	15.1
Personnel management	3.34	19	14.4	10.3	1.3	25.0	38.8	10.3
Bibliographic tools	3.32	20.5	33.7	2.2	3.8	21.6	32.8	5.9
Integrated library systems	3.32	20.5	13.5	1.7	2.1	25.1	42.2	15.4
Staff development	3.29	22	9.2	9.0	1.6	23.6	43.6	13.0
Database construction	3.28	23	16.8	6.0	2.2	24.8	37.0	13.1
Identification of materials and sources	3.27	24	29.7	2.8	3.8	20.9	35.8	7.0
National Library of Medicine programs and policies	3.24	25	13.2	1.3	4.3	27.4	37.3	16.4
Institutionwide information management	3.23	26	7.9	5.2	2.1	17.8	51.2	15.9
Services and project management	3.22	27	9.7	6.9	2.5	20.8	46.6	13.4
Information systems—design, use, evaluation	3.20	28	19.4	6.1	1.9	23.1	35.3	14.2
Program evaluation	3.19	29	12.7	8.2	2.0	24.0	40.6	12.5
Serial publications	3.16	30.5	27.7	1.6	4.4	15.5	42.1	8.7
Organizational behavior	3.16	30.5	12.0	14.4	1.8	18.0	41.7	12.2
Interinstitutional relations	3.13	32	7.5	5.9	3.0	14.4	56.5	12.8
Human behavior and technology	3.07	33	10.9	12.3	1.2	22.4	34.4	18.9
Formats of information	3.05	34	30.1	2.0	2.5	19.7	35.6	10.1
Space planning	3.01	35	19.7	4.2	1.2	19.0	43.6	12.3

of knowledge and skill in some areas of management, as is continuing education. Regarding knowledge and skills important to current position and for the future, the original response pattern was maintained. In general, the data suggest that library schools are seen as preferred sources of knowledge and skills in areas other than those held by the respondents and well beyond the arena traditionally assigned to librarianship.

OUTCOMES AND IMPLICATIONS

A major outcome of the survey was *Platform for Change*, the educational policy statement adopted by the MLA Board of Directors in December 1991. *Platform for Change* breaks new ground in its approach to and structure for education and professional development. Avoiding the typical patchwork of novel notions and suggestions for improving graduate and continuing education, the document proposes a highly collaborative, integrated, and individual-centered

approach. Moreover, *Platform for Change* provides concrete guidelines for graduate programs in health sciences librarianship and a practical framework for educational programs coordinated by MLA, NLM, and other groups positioned to address the professional development needs of medical librarians.

Providing the foundation for *Platform for Change* are a number of conclusions drawn from the survey data that cannot be overlooked.

First, as libraries enter the twenty-first century, they will be doing so with many of the health sciences librarians currently employed. Librarians already employed in health care institutions are likely to be in the profession for the next fifteen years. Not only will this post–master's degree cadre need to assume greater responsibility for its own continuing education, but it also will look to employers for support of training and continuing education, both on the job and provided by other organizations and institutions. It is likely, therefore, that this group will demand programs from professional associations that

Table 7
Where best acquired, ranked by importance now; knowledge bases 3.0 and above

| Knowledge base | Importance | | % where acquired | | | | | |
	Mean	Rank	Library school	Other formal academic programs	Internship	Continuing education	On the job	Other
Oral and written communication	3.75	1	18.9	32.2	5.6	22.3	20.9	9.8
Health sciences practitioners' need	3.67	2	19.6	5.1	13.3	25.8	36.2	8.2
Health sciences information resources	3.66	3	28.7	4.0	10.7	25.4	26.4	4.9
Retrieval techniques	3.64	4	28.5	3.8	10.4	27.6	26.0	3.8
Selection of information resources	3.44	5	31.9	2.6	8.7	25.4	26.4	4.0
Planning	3.41	6	27.7	13.7	5.9	24.9	22.6	5.1
Budgeting	3.40	7	17.3	14.4	5.1	23.2	27.2	3.6
Interpersonal relations	3.38	8	15.8	13.4	5.2	21.7	25.4	8.1
Computer software	3.37	9	24.1	10.3	6.6	27.1	25.4	6.5
Development of services for information needs	3.36	10	27.0	4.2	9.4	25.6	28.5	5.2
Bibliographic tools	3.34	11	35.5	2.2	7.4	24.6	26.3	4.0
Methods of information delivery	3.33	12	30.7	3.5	10.2	25.1	26.7	3.7
Health sciences environment	3.32	13	15.1	8.3	13.1	26.8	30.6	6.0
Resource sharing	3.31	14	27.6	1.8	4.6	24.0	35.4	6.7
Telecommunications and networking	3.27	15.5	25.9	10.2	6.5	26.8	30.6	6.0
Information needs assessment	3.27	15.5	28.9	6.3	9.2	25.7	24.5	5.4
Public relations and marketing	3.25	17	22.0	18.0	5.0	27.8	21.9	5.3
Personnel management	3.22	18	23.1	16.4	4.5	25.7	24.6	5.7
Evaluation and synthesis of information	3.20	19	28.6	8.4	8.6	24.4	25.0	5.0
Identification of materials and sources	3.19	20	32.7	2.2	9.1	23.1	28.8	4.1
Staff development	3.18	21	21.4	13.6	4.2	29.1	25.6	6.1
Serial publications	3.14	22	36.8	1.5	4.4	22.7	30.1	4.5
Computer hardware	3.12	23.5	23.5	10.9	6.7	27.0	25.4	6.4
National Library of Medicine programs and policies	3.12	23.5	17.5	2.1	7.8	23.7	21.0	8.2
Services and project management	3.08	25	23.3	12.1	6.9	26.5	26.3	4.9

strengthen professional competence, programs tailored to the needs of mature individuals seasoned in medical library practice.

Second, it is significant, generally speaking, that the skills least likely to be held by health sciences librarians are also among those considered by respondents to be least important to the profession now and in the future. Perhaps more significant, however, is the lack of current knowledge in key areas identified as important now and in the future (i.e., planning, budgeting, computer software, telecommunications and networking).

Table 8
Where best acquired, ranked by importance in present position; knowledge bases 3.0 and above

| Knowledge base | Importance | | % where acquired | | | | | |
	Mean	Rank	Library school	Other formal academic programs	Internship	Continuing education	On the job	Other
Oral and written communication	3.67	1	18.9	32.2	5.6	22.3	20.9	9.8
Health sciences practitioners' need	3.55	2	19.6	5.1	13.3	25.8	36.2	8.2
Interpersonal relations	3.47	3	15.8	13.4	5.2	21.7	25.4	8.1
Health sciences information resources	3.46	4	28.7	4.0	10.7	25.4	26.4	4.9
Retrieval techniques	3.37	5	28.5	3.8	10.4	27.6	26.0	3.8
Planning	3.27	6	27.7	13.7	5.9	24.9	22.6	5.1
Selection of information resources	3.23	7	31.9	2.6	8.7	25.4	26.4	4.0
Computer software	3.22	8	24.1	10.3	6.6	27.1	25.4	6.5
Methods of information delivery	3.18	9	30.7	3.5	10.2	25.1	26.7	3.7
Information needs assessment	3.17	10	28.9	6.3	9.2	25.7	24.5	5.4
Bibliographic tools	3.15	11	35.5	2.2	7.4	24.6	26.3	4.0
Telecommunications and networking	3.14	12	25.9	10.2	6.5	26.8	30.6	6.0
Development of services for information needs	3.13	13	27.0	4.2	9.4	25.6	28.5	5.2
Health sciences environment	3.12	14	15.1	8.3	13.1	26.8	30.6	6.0
Identification of materials and sources	3.07	15	32.7	2.2	9.1	23.1	28.8	4.1
Resource sharing	3.02	16	27.6	1.8	4.6	24.0	35.4	6.7
National Library of Medicine programs and policies	3.01	17	17.5	2.1	7.8	23.7	21.0	8.2

Table 9
Where best acquired, ranked by importance in twenty-first century; knowledge bases 3.0 and above

Knowledge base	Importance		% where acquired					
	Mean	Rank	Library school	Other formal academic programs	Internship	Continuing education	On the job	Other
Oral and written communication	3.80	1	18.9	32.2	5.6	22.3	20.9	9.8
Health sciences practitioners' need	3.78	2	19.6	5.1	13.3	25.8	36.2	8.2
Retrieval techniques	3.71	3	28.5	3.8	10.4	27.6	26.0	3.8
Health sciences information resources	3.66	4	28.7	4.0	10.7	25.4	26.4	4.9
Budgeting	3.58	5	17.3	14.4	5.1	23.2	27.2	3.6
Telecommunications and networking	3.57	6.5	25.9	10.2	6.5	26.8	30.6	6.0
Computer software	3.57	6.5	24.1	10.3	6.6	27.1	25.4	6.5
Planning	3.56	8	27.7	13.7	5.9	24.9	22.6	5.1
Methods of information delivery	3.49	9.5	30.7	3.5	10.2	25.1	26.7	3.7
Health sciences environment	3.49	9.5	15.1	8.3	13.1	26.8	30.6	6.0
Information needs assessment	3.48	11.5	28.9	6.3	9.2	25.7	24.5	5.4
Development of services for information needs	3.48	11.5	27.0	4.2	9.4	25.6	28.5	5.2
Selection of information resources	3.47	13.5	31.9	2.6	8.7	25.4	26.4	4.0
Public relations and marketing	3.47	13.5	22.0	18.0	5.0	27.8	21.9	5.3
Resource sharing	3.46	15.5	27.6	1.8	4.6	24.0	35.4	6.7
Evaluation and synthesis of information	3.46	15.5	28.6	8.4	8.6	24.4	25.0	5.0
Interpersonal relations	3.42	17	15.8	13.4	5.2	21.7	25.4	8.1
Computer hardware	3.36	18	23.5	10.9	6.7	27.0	25.4	6.4
Personnel management	3.34	19	23.1	16.4	4.5	25.7	24.6	5.7
Bibliographic tools	3.32	20.5	35.5	2.2	7.4	24.6	26.3	4.0
Integrated library systems	3.32	20.5						
Staff development	3.29	22	21.4	13.6	4.2	29.1	25.6	6.1
Database construction	3.28	23	31.4	9.0	6.3	27.7	21.2	4.4
Identification of materials and sources	3.27	24	32.7	2.2	9.1	23.1	28.8	4.1
National Library of Medicine programs and policies	3.24	25	17.5	2.1	7.8	23.7	21.0	8.2
Institutionwide information management	3.23	26	22.9	12.4	6.1	23.6	28.8	6.1
Services and project management	3.22	27	23.3	12.1	6.9	26.5	26.3	4.9
Information systems—design, use, evaluation	3.20	28	22.5	11.7	6.6	25.6	25.4	4.7
Program evaluation	3.19	29						
Serial publications	3.16	30.5	36.8	1.5	4.4	22.7	30.1	4.5
Organizational behavior	3.16	30.5	22.5	18.4	5.9	22.8	24.7	5.7
Interinstitutional relations	3.13	32	18.3	9.8	6.6	21.8	36.9	6.6
Human behavior and technology	3.07	33	24.0	19.5	4.6	25.2	20.3	6.3
Formats of information	3.05	34	37.0	2.9	5.1	23.6	25.5	6.1
Space planning	3.01	35	31.4	8.3	3.3	28.1	24.4	4.5

To be sure, in this, as in all such future-oriented exercises, it is very difficult for individuals close to an operation to project themselves very far into the future. Despite what respondents imagined as necessary and important in the future, it is certain that the rapidly changing health care environment, coupled with the explosion of technological capabilities, will change the way health sciences libraries and information professionals operate. Feedback to the task force from the non-MLA survey participants and expert reviewers yielded some disturbing results in this regard. The "outsiders" had a much more expansive view than MLA librarians of what health sciences should and could be doing in the future. Health professionals, for example, seem to expect a greater role for information professionals than librarians themselves seemed willing to assume, based on the kinds of knowledge and skills respondents saw as critical and important to professional practice. Experts from outside medical librarianship made it clear that if health sciences librarians are not willing to take on the responsibilities their clients feel are important,

these librarians doubtless will be replaced by professionals who can and will. MLA and individual health sciences librarians must act decisively to prepare for a world that continues to change radically in response to the rapid growth of biomedical knowledge and technical power.

Third, there was no consensus among the respondents as to the "best" place to learn specific skills or knowledge. For skills closely connected with library functions and the processing of information, the library school seems well positioned. Still, many respondents felt that continuing education and on-the-job training were reasonable approaches for attaining even the basic skills of librarianship. Clearly, the development of a common learning and professional development agenda will require collaboration among universities, graduate institutions of library and information studies, MLA and other professional associations, commercial vendors and publishers, and employers.

The survey undertaken by MLA's Knowledge and Skills Task Force and the resulting *Platform for Change*

together underscore the need to reconsider and re-shape the educational process and content that pre-pare new information professionals and sustain and enhance the skills and knowledge of current librar-ians.

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APPENDIX A
Medical Library Association
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