Curricula in Information Science: Four Year Progress Report*

This is our second study of curricula in information science. It provides a basis for comparison of the 1968 curricula with those of 1972, observing trends in the educational system in information science. Since this study solicited information on all three educational levels, the statistics describing all programs are given; comparisons are made at the MS level only, using the 1968 data. These indicate a curriculum shift from traditional librarianship to an emphasis on computerization and automation. This trend appears to encompass theory as well as technology.

The most frequently offered course "Introduction to Information Science," exposes students to a new way of looking at library and information problems. Programming, theories of information content identification, library automation and some basic mathematics has increased. If the trend continues, libraries may be turning into *Community Information Centers* utilizing telecommunication for their information needs.

Deans, faculty, professional society and industry representatives reviewed the questionnaire analysis results in Workshop III and made recommendations for educational goals and curricula on three levels, *i.e.*, the bacculaureate, masters and doctorate.

Jack Belzer
James Williams
John Kronebusch and
A. B. Gupta
University of Pittsburgh
Pittsburgh, Pennsylvania 15213

• Introduction

It is important to know the state of education in information science, but it is equally important to know the direction in which it is going. If education can be tied in with societal needs and career opportunities, then it is mandatory to give it direction.

In pursuit of answers to the above, a questionnaire similar to the one used in our 1968 study (*1*) was employed to solicit information regarding curricula in schools offering programs in information science. The responses reflect programs which existed in 1972-3. A comparison reflects changes in curricula during a critical four year period in the developing field of information science. A much larger population of schools was used in the '72-'73 sample because the solicitation was expanded to include all three levels of education, *i.e.*, B.S., M.S. and Ph.D. The previous study covered the master's programs only.

Where comparisons are made, only schools which participated in both studies are included. Thus comparisons are made for programs on the master's level only. Programs on the baccalaureate and the Ph.D. levels merely reflect the present state and are reported as such.

Many information science programs, especially those on the baccalaureate level, are tied closely to computer science and in some instances are precisely that, under an information science label. It is difficult to draw a clean line of demarcation between the two, and while an attempt was made to keep this study uncontaminated a bias is noticeable.

• Questionnaire Statistics

Questionnaires were mailed to 138 schools, 71 of which responded. A total of 566 courses were described. Many of the schools which did not respond had their programs identified as computer science. Of the 44 schools which responded in 1968, the Universities of Dayton and Portland discontinued their programs in information science and seven others did not respond—leaving 35 schools common to both studies offering master's degrees. As in the previous study, the major focus of analysis was on the clustering of topics enumerated in the syllabi. The general statistics about the programs which follow are of considerable importance. This is especially so because a comparison between 1968 and 1972 indicated change during the last four years.

The courses most frequently offered by all schools, irrespective of their orientation or the level of the programs, are shown in Table 1a.

*This research was made possible through NSF Research Grant No. GZ-2525

Table 1a

Course Titles	1968 No.	1972 No.
• Introduction to Information Science	18	51
• Systems Analysis, Design, Evaluation	12	47
• Information Storage & Retrieval	36	43
• Data Processing	7	33
• Computer Programming	6	29
• Theory of Classification, Indexing, Abstracting, etc.	--	23
• Communication	--	22
• Library Automation	15	19
• Mathematics	9	18
• Research Methods in Information Science	10	11
• Data Structures (File Organization)	--	11
• Interactive Systems and Networks	--	11
• Language & Linguistics	9	--

It is interesting to note that "Introduction to Information Science" has captured the lead from "Information Storage and Retrieval" (I S & R) of the previous study. Several other changes have taken place, and in each case theory and structure courses are replacing applications types. In our opinion, this indicates some maturing in the field.

The data which follow are given as percentages so that comparisons between 1968 and 1972 can be made. Only schools which offered masters programs and responded in both years have been included.

Table 1b shows a considerable change in orientation and emphasis in curricula. Courses in information science changed their orientation from Library Science to Computer Science by ten percent. This is an important change in emphasis. The direction is to more computer utilization at the expense of traditional library functions.

Table 1b

Orientation of Courses:	1968 %	1972 %
Computer Science	20	30
Library Science	42	30
Behavioral Science	6	5
Mathematics & Logic	9	7
Statistics	2	2
Operations Research	6	5
Linguistics	4	5
Engineering	1	5
Other	10	11

Method of Instruction (Table 1c) as well as Textbook Used (Table 1d) are rather disappointing. We feel that graduate programs should be more seminar and laboratory oriented than those which have been reported. Lecturing at graduate students is undignified. Similarly, reference books and journal articles are thought more appropriate for graduate study than textbook assignments. Evaluation of student performance should be made on ability to deal with long range projects and/or in-depth reports. Examinations (Table 1e), for which predetermined replies are expected do not measure such progress.

Table 1c

Method of Instruction:	1968 %	1972 %
Lecture	58	57
Seminar	19	20
Laboratory	18	14
Practicum	5	9

Table 1d

Textbook Used in the Course:	1968 %	1972 %
Yes	49	53
No	48	13
No Response	3	34

Table 1e

Method of Performance Evaluation	1968 %	1972 %
Examinations	45	48
Term Papers	40	35
Projects	15	17

Table 1f shows that electives dominate graduate degree programs in information science, as they should. The interdisciplinary nature of the field permits graduates to pursue diverse interests.

Table 1f

Required or Elective:	1968 1%	1972 %
Required	30	33
Elective	56	61
No Response	14	6

Offering courses more frequently than once a year is not frugal, and constraints to conserve resources are more visible now than they were in 1968. Obviously, this provides greater efficiency in academic programs.

Table 1g shows that 60% of all courses are offered not more frequently than once a year.

Table 1g

Frequency of Offering Per Year:	1968 %	1972 %
Less than once	6	9
Once	40	51
Twice	32	26
More than twice	22	14

The stabilization of the academic programs in information science during the last four to five years has shown a shift in the direction of the scientific method. With this we note a tendency to automate processes which previously were performed manually. In the academic environment such shifts must be reflected in the books which are used in the classroom and in the overall educational process. The book most frequently mentioned and used in 17 courses is the *Handbook of Data Processing for Libraries* by R. Hayes and J. Becker. Table 1h provides a list of textbooks used with frequencies ranging from 17 to five. Books which were mentioned less than five times are not given here. Appendix C lists *all* textbooks and their frequencies as determined by the questionnaire.

Table 1h

The Following Texts had Frequency Ranges of 17 to 5:	
Hayes, R. and J. Becker, *Handbook of Data Processing for Libraries*, New York: John Wiley (1970).	*(17)
Artandi, S., *An Introduction to Computers in Information Science* (2nd ed.), Metuchen, NJ: Scarecrow Press (1972).	(9)
Salton, G., *Automatic Information Organization and Retrieval*, New York: McGraw-Hill (1968).	(9)
Hopcroft, J.E. and J.D. Ullman, *Formal Languages and the Relation to Automata*, Reading, MA: Addison–Wesley (1969).	(8)
Knuth, D.E., *Art of Computer Programming, Vol. I: Fundamental Algorithms*, Reading, MA: Addison–Wesley (1968).	(8)
Lancaster, F.W., *Information Retrieval Systems*, New York: Wiley (1968).	(7)
McCracken, D.D. and U. Garbassi, *A Guide to COBOL Programming* (2nd ed.), New York: Wiley (1970).	(7)
Griswald, R., *et al.*, *The SNOBOL-Four Programming Language* (2nd ed.), Englewood Cliffs, NJ: Prentice-Hall (1971).	(6)
Bell, C.G. and A. Newell, *Computer Structures Reading and Examples*, New York McGraw-Hill (1971).	(5)
Chapman, E.A., *Library Systems Analysis Guidelines*. New York: John Wiley, (n.d.)	(5)
Foskett, A.C., *The Subject Approach to Information* (2nd ed.), Hamden CN: Shoestring Press (1971).	(5)
Gries, D., *Compiler Construction for Digital Computing*, New York: John Wiley (1971).	(5)

*Indicates the number of times the book was mentioned in the questionnaire.

The major concentration of the cluster analysis was focused on the syllabi which described course content for every course covered in the study. All of the topics included constituted material which fits under the umbrella of information science for which a cluster analysis of the topics was made. Clusters were formed by developing associative matrices, *i.e.*, frequencies of co-occurrence of topics with hours spent on each topic (*3*).

- **Clusters from M.S. programs**

Seven clusters were obtained on the master's level, compared to six produced by the 1968 study. However, the differences among these are much greater. In the 1968 study, much longer lists of topics appeared under each cluster than in the 1972 study, (Tables 2a through 2g). The reason for this reduction in the number of topics is due to the close agreement of topics among the schools. It is interesting to note that two clusters, "Mathematics" and "Research Methods," disappeared in the second study. In their place clusters under headings of "Library Automation," "Computer Operating Systems" and "Theory of Computing" appeared on the scene. The present study indicates that education in information science is beginning to see the convergence of subjects in the curricula that rightfully belong in the field.

Table 2a

Cluster 1: Introduction to Information Science
Coding
Communication
Cybernetics
Decision processes
Information services
Information systems environment
Information theory
Languages–linguistics

Table 2b

Cluster 2: Systems Evaluation
Evaluation methodology
Evaluation of information systems
Measures of effectiveness
Systems analysis
System design

Table 2c

Cluster 3: Introduction to Computers
Computer programming Computers Data processing Data processing equipment Flowcharting Hardware Languages–general Software

Table 2d

Cluster 4: Computer Operating Systems
Compilers Machine languages Multiprogramming Operating systems Time-sharing

Table 2e

Cluster 5: Information Storage and Retrieval
Abstracting Automatic information storage and retrieval Classification Fact retrieval File organization Indexing Role of theory in retrieval Search strategy Search techniques Thesaurus

Table 2f

Cluster 6: Theory of Computing
Algorithms Automata theory Finite state machines Recursive function theory Turing machines

Table 2g

Cluster 7: Library Automation
Circulation systems Library automation Library and information networks Library standards MARC system Planning, staffing, and implementation of library automation

• Questionnaire Statistics 1972: B.S., M.S. and Ph.D.

The tables for the remainder of the paper represent the state of programs during the 1972-73 year for the B.S., M.S. and Ph.D. levels.

Table 3a shows that at the B.S. level the greatest emphasis is on computer science and library science. Engineering and mathematics ranked next in that sequence. The emphasis is on technology. On the master's level, graduates become professional librarians and information scientists, with greater emphasis on library science. At the Ph.D. level, computers again play a dominant role. As the educational levels rise from the B.S. to the Ph.D., more emphasis is being placed on behavioral science and mathematics and logic. The opposite is true for engineering.

Table 3a

	1972			
Orientation of Courses	B.S. %	M.S. %	Ph.D. %	All levels %
Computer Science	56	31	43	37
Library Science	10	31	10	25
Behavioral Science	2	7	10	7
Mathematics & Logic	7	6	9	7
Statistics	1	3	4	2
Operations Research	2	5	3	4
Linguistics	2	4	5	3
Engineering	8	4	4	5
Other	12	9	12	10

It is disappointing to see that the lecture method for teaching at the Ph.D. level is as high as indicated in Table 3b. It is gratifying that the seminar method is utilized substantially more at the higher levels than that at the baccalaureate level. Lecturing at mature people is not only undignified but also is not conducive to learning.

Learning is best accomplished by teaching others, and the seminar method can provide such opportunities. Laboratory and practicum experiences relate to experiences acquired in real situations, devoid of theoretical aspects. For this reason laboratory and practicum experiences decrease as the educational level rises. In the same sense, Table 3c indicates that textbook usage at higher levels of education is less than at the bachelor's level. Certainly reference materials and professional journal readings should be the main source for acquiring knowledge at the Ph.D. level where the state-of-the-art is of the essence.

Table 3b

	1972			
Method of Instruction	B.S. %	M.S. %	Ph.D. %	All levels %
Lecture	57	52	68	54
Seminar	10	22	16	19
Laboratory	27	17	10	19
Practicum	6	9	6	8

Table 3c

	1972			
Textbook Used in the Course	B.S. %	M.S. %	Ph.D. %	All levels %
Yes	75	53	58	57
No	6	8	5	8
No response	19	39	37	38

Methods of evaluating student performance (Table 3d) should deemphasize examinations and exercise assignments and stress long-range performance and ability to integrate as the educational level rises. The ability of students to prepare, organize and deliver a seminar presentation and/or develop term papers on a given or selected theme are better indicators of student growth than examinations which elicit specific responses.

Table 3d

Frequency of Offering per year	1972 B.S. %	M.S. %	Ph.D. %	All levels %
Less than once	2	11	15	8
Once	34	52	55	49
Twice	31	21	20	23
More than twice	33	16	10	20

Graduate students should be able, with the aid of advisors, to select an educational program to meet their special needs and career desires. The more flexible the program, the easier this is to accomplish. Less constraint (required courses) and more electives, as shown in Table 3e, provide such flexibility.

Table 3e

Required or Elective	1972 B.S. %	M.S. %	Ph.D. %	All levels %
Required	49	30	29	35
Elective	46	63	66	58
No response	5	7	5	7

Economic constraints in education demand efficiency. The frequency with which courses are offered is a measure both of demand and economy. The more advanced the program the less reason for offering courses too frequently. Frequent course offerings should support prerequisites. Table 3f demonstrates this reasonably well.

Table 3f

Method of Performance Evaluation	1972 B.S. %	M.S. %	Ph.D. %	All levels %
Examination	66	47	52	51
Term Papers	12	34	38	30
Projects	22	19	10	19

- **Cluster Analyses for All Levels 1972**

The cluster analyses are of interest because they emphasize the differences in programs on various levels, although the general theme of information science permeates all levels. For example, the cluster "theory of organization of knowledge" in the bachelor's program is absorbed by the cluster "information storage and retrieval" in the master's program. The cluster, "theory of organization of knowledge," on the Ph.D. level, (Tables 5a-5k) takes on new dimensions. Similarly, it can be observed that in the bachelor's program students get a sound foundation in computer science oriented topics. In the master's program they go into library automation where computers are utilized. On the Ph.D. level, "library systems" and "advanced topics in computer science" replace the applied approach of the M.S. level. Programs on all levels recognize the need for mathematics; however, the strong emphasis on statistics and on research methods in the Ph.D. program stresses the importance of research at this level.

Tables 4a to 4h show the clusters that were obtained at the bachelor's level, tables 5a to 5k at the Ph.D. level and tables 6a to 6k at the combined (B.S., M.S. and Ph.D.) levels.

B.S. Clusters 1972

Table 4a

Cluster 1: Introduction to Information Science.
Coding
Communication
Information needs
IS&R
Information theory
MIS
Search techniques

Table 4b

Cluster 2: Theory of Organization of Knowledge.
Abstracting
Cataloging
Classification
Indexing

Table 4c

Cluster 3: Linguistics
Descriptive grammar Generative grammar Linguistics & information processing Natural language analysis Phonology Statistical linguistics

Table 4d

Cluster 4: System and Evaluation
Evaluation methodology Measure of effectiveness Model building Systems analysis Systems design

Table 4e

Cluster 5: Mathematics
Calculus Differential equations Lagrange's multipliers Linear programming Mathematics & Logic Non-linear programming Set theory Vectors & matrices

Table 4f

Cluster 6: Introduction to Computers
Computer programming Computers Data processing Flowcharting Hardware Languages–general Software

Table 4g

Cluster 7: Computer Operating Systems
Computers Machine Language Multiprogramming Operating Systems Time Sharing

Table 4h

Cluster 8: Data Base Structures
File organization Information structures Linked lists Tree structures

Ph.D. Clusters 1972

Table 5a

Cluster 1: Information Systems
Coding File organization History of science Information structures Information theory Information systems Management information systems Search strategy Tree structures

Table 5b

Cluster 2: Library Systems
Circulation systems Library automation Library standards MARC standards Planning, staffing & implementation of library automation project

Table 5c

Cluster 3: Theory of Organization of Knowledge
Abstracting Classification Indexing Information Storage & Retrieval Thesaurus

Table 5d

Cluster 4: Linguistics
Context-free languages Generative grammar Languages-general Linguistics & information processing

Table 5e

Cluster 5: Evaluation of Systems
Evaluation methodology Evaluation of IS & R systems Measures of effectiveness Systems analysis Systems design

Table 5f

Cluster 6: Research Methods
Communication Design of experiments Information center & mass communication Media Psychology Research techniques

Table 5g

Cluster 7: Mathematics
Calculus Differential equations Descriptive statistics Mathematics & logic Vectors & matrices

Table 5h

Cluster 8: Statistics
Decision process Probability distribution Queueing Sampling Statistical analysis Statistical decision theory.

Table 5i

Cluster 9: Computer Programming
Programming Computers Data processing Hardware Machine language Software

Table 5j

Cluster 10: Computer Operating Systems
Compilers Multiprogramming Operating systems Time-sharing

Table 5k

Cluster 11: Theory of Computing
Algorithms Automata theory Finite state machines Recursive function theory Set theory Turing machines

Tables 6a to 6k, clusters obtained from topics on all levels, define the information science field as it exists today. The 11 clusters which follow emphasize the interdisciplinary nature of the field.

1. Foundations of Information Science
2. Theory of Organization of Knowledge
3. Theory of Computing
4. Computer Methods
5. Data Processing
6. Automation of Library Systems
7. Management in Libraries
8. Systems Evaluation
9. Behavioral Aspects
10. Statistics
11. Mathematics

General (B.S. + M.S. + Ph.D.) Clusters, 1972

Table 6a

Cluster 1: Foundations of Information Science
Information theory Communication History of science Coding Media Linguistics & information processing Information displays Information explosion Libraries & communication Information sciences Information storage & retrieval Search strategy Sociological aspects

Table 6b

Cluster 2: Theory of Organization of Knowledge
Abstracting Indexing Extracting Classification Cataloging Content analysis Bibliographic control

Table 6c

Cluster 3: Theory of Computing
Information structure
Algorithms
Countability
Sequential nets
Switching theory
Automata theory
Turing machines
Finite state machines
Meta-mathematics
Recursive function theory

Table 6d

Cluster 4: Computer Methods
Computers
Operating systems
Compilers
Machine language
Time sharing
Multi programming
Computer utility
Linked list
Tree structure
File organization

Table 6e

Cluster 5: Data Processing
Computer programming
Software
Hardware
Flowcharting
Punched cards
Data collection methods
Data processing equipment
Recording media
Dial-up access
Telecommunication
Networks

Table 6f

Cluster 6: Automation of Library Systems
Planning, staffing & implementation of library automation
Circulation system
Microforms
Automation of serials
MARC system
MEDLARS
Mechanized cataloging
Automation of book reservation system

Table 6g

Cluster 7: Management in Libraries
Library & information networks
Library functions
Library standards
Managerial objectives
Future of libraries
Professional aspects
Library associations
University libraries

Table 6h

Cluster 8: System Evaluation
Evaluation methodology
Evaluation of information retrieval systems
Measures of effectiveness
Planning, programming & budgeting (PPB)
Operations research & information systems
Systems design
Systems analysis
Decision Processes
Model building
Work measurement
Systems synthesis
Queueing

Table 6i

Cluster 9: Behavioral Aspects
Psychology
Human information processing
Concept formation
Thinking
Feedback and control

Table 6j

Cluster 10: Statistics
Research techniques
Scientific method
Design of experiments
Interpretation of statistical results
Statistical decision theory
Factor analysis
Analysis of variance
Tests of hypotheses
Descriptive statistics
Probability distribution
Sampling
Regression & correlation
Statistical analysis

Table 6k

Cluster 11: Mathematics
Mathematical logic
Calculus
Vectors & matrices
Differential equations
Algebra
Linear programming
Non-linear programming
Dynamic programming
Lagrange's multipliers
Topology
Set theory
Graph theory

• Workshop III

As in the previous studies (*1-3*), a workshop was conducted to which participants representing academia, industry, government and professional societies were invited. The specific goal of this workshop was to develop recommendations for curricula in information science at three levels, baccalaureate, master's and the Ph.D. The two-day workshop involved 23 participants (Appendix A)

On the first day, the questionnaire statistics and their implications were presented to the group by Jack Belzer. C. Walter Stone, chairman of a task force on education of the Center for the Study of Information and Education (CSIE) presented his report, "Curricula Reform of Library and Information Science," (*4*) and Donald P. Ely, Director of CSIE, reported on "Information Systems and New Towns," and "Information Delivery Systems of Non Traditional Study." William J. Cameron, Dean of the School of Library and Information Science at the University of Western Ontario, gave a report on the seminar method of teaching at his school. After discussion of the four papers, three subgroups were formed, one for the undergraduate curriculum, chaired by Vivian S. Sessions of the City University of New York Graduate School, one for the master's program, chaired by Pauline Atherton of the Syracuse University School of Information Studies, and a third for the Ph.D. program, chaired by Margaret Chisholm, Dean of the University of Maryland College of Library and Information Services. The following afternoon each subgroup submitted recommendations for curricula for its assigned level. The subgroup working on the master's program developed a generalized model for all levels of study. It identified four types of knowledge required with a different emphasis in each.

Table 7 presents this model. It is being presented here because of its overall implications.

Table 7

	Theory	Concepts	Tools	Application
Ph.D.	xxxx	xx	x	xxx
Masters	x	xx	xxx	xxxx
Bachelors	x	xxx	xxxx	xx

(x=relative degree of emphasis)

• Undergraduate Program Recommendations

The undergraduate degree in information science was not considered to be a professional degree by the working group. Instead it was looked upon as a degree in the School of Arts and Sciences with a *major* in information science. (A major in arts and sciences consists of 30 to 36 credits with a possible 12 credits in a related field.) Because of the interdisciplinary nature of information science, seven areas were identified as composing the field. Concentration in any one area is possible, depending on the speical interest of the student, and should be planned with the aid of his advisor. Certainly, if this is going to be a terminal degree the student should acquire skills which would help him to cope with his desired pursuit. His exit knowledge should correspond. The seven areas composing the field are:

- Technology
- Theory of Organization
- Mathematics
- Language and Linguistics
- Basic Sciences
- Management Theory

Technology includes computers, transmission and microphotography. Theory of organization covers topics in file structures, indexing and the philosophy of organization of human knowledge. Mathematics is to equip the student with tools for quantitative analysis and give him new insights into concepts which are mathematically characterized—such as the concepts of limits, rates of convergence, iterative processes, acceleration rates and statistical distributions. Language and linguistics imply both natural and artificial languages.

No one is expected to wind up with long sequences of courses in each of the seven areas. Since education in arts and sciences implies course distribution, a sampling of courses in these seven areas is indicated. A minor in a related field can be obtained in mathematics, computer science, management science or some other field. In addition, the candidate can obtain in-depth knowledge in a combination of two or three of the other areas as part of his major. In this program, not all graduates are going to look alike. This is as it should be. Each can pursue his special interests. The program places its major emphasis on tools and the secondary emphasis on concepts (Table 7).

Of all the areas identified by the subgroup on undergraduate education, the one that is conspicuously absent from the cluster analysis is management theory. It is recommended that management theory be included in curricula of undergraduate programs in information science.

• Master's Curriculum Recommendations

In the master's program, strong emphasis is placed on applications and tools and to a lesser degree on concepts and theory (Table 7).

A. *Applications*
1. Operation of Systems
   a. Libraries and Information Centers
   b. Networking (Information/Communication)
2. Media Technology and Transmission
   a. Print and Nonprint Technology
   b. Media Distribution
   c. Cable T.V.
3. Consumer Environments
   a. Different Client and Service Needs
   b. Social Issues and Public Policy
   c. Requirement Analysis
   d. Human Communication Process
   e. Response Analysis and Design
   f. Capacity and Efficiency of Various Media and Systems for Different Clientele

B. *Tools*

There are two classes of tools, those directly related to information science and those adjunctive to it.

1. Information Storage and Retrieval
   a. Content analysis
   b. Abstracting and indexing
   c. Classification
   d. Thesaurus structures
   e. Search strategies
2. Management
   a. Measures of effectiveness
   b. Systems analysis and design
3. Adjunctive Areas
   a. Mathematics and statistics
   b. Languages
   c. Data processing
   d. Management planning
      1) Finance and budgeting
      2) Marketing
      3) Personnel data

C. *Theories and Concepts*
1. Introduction to Information Science
2. Philosophy
3. Information Systems
   a. Vocabulary control
   b. Indexing and classification
   c. File structures
4. Adjunctive Areas
   a. Theory of communication and information
   b. Group dynamics
   c. Decision theory
   d. Computing theory
   e. Linguistics

The adjunctive areas are not part of the information science curriculum. It would be convenient if they were prerequisites for admission to a master's program in information science. Since admission to the program would come from a variety of majors with BA/BS degrees, it would be unrealistic to expect all applicants to have the same skills upon admission to the program. It is recommended that master's program in information science be sufficiently flexible to deal with these situations.

The cluster analysis of the master's program does not show any topic on media technology recommended by the subgroup, nor is there a cluster where such a topic would logically fit. Professional practitioners in information science should be knowledgeable in the technology of media.

• Ph.D. Curriculum Recommendations

The Ph.D. level working group identified five functions in which Ph.D.'s in information science would be involved. They are research, teaching, administration, development and consultation. An individual would perform any one, or a combination of more than one, of these functions, but rarely across the entire spectrum. In order for an individual to be flexible enough to be able to operate in any of the five areas enumerated above, he must be a scholar. He must be able to bridge (and carry over applicable knowledge and experience) from one area to the other. Research methodology and results are brought into the classroom, and classroom discussions generate new methodology in the research laboratory. Basic theories underlying tools (which were acquired in lower level programs), provide concepts and better understanding of existing phenomena. Creativity results from better understanding of *why* certain phenomena occur, rather than merely *how* they occur, or that they occur at all. The ability to conduct research to discover why certain phenomena occur is a form of competence which goes along with scholarship. It is possible that someone who has a strong research competence may not be suited to be a practitioner in the field. Nevertheless, special competence in: research methods and techniques, the application of these techniques, the understanding of the environment in which the researcher is working, and the social conciousness of the way in which information systems work, all relate to research competence which is needed, above all, in the Ph.D. program.

References

1. Belzer, J. (Ed.), "Information Science Education: Curriculum Development and Evaluation," *American Documentation* 20 (No. 4): 327-376 (1969).
2. ———, "Education in Information Science" *Journal of the American Society for Information Science* 21 (No. 4): 269-273 (1970).
3. ———, A. Isaac, *et al.*, "Curricula in Information Science Analysis and Development" *Journal of the American Society for Information Science* 22 (No. 3): 193-223 (1971).
4. Stone, C.W., J. Belzer and J.W. Brown, *Needs for Improvement of Professional Education in Library and Information Science*, Center for the Study of Information and Education, Syracuse University, Syracuse, NY (1973).
5. Belzer, J., "Curriculum Trends for Information Science Professionals" *Educational Media Yearbook 1974* J.W. Brown [Ed.], New York: R.R. Bowker Co., 28-30 (1974).

Appendix A: Participants-Workshop III

Pauline Atherton, U. of Syracuse
Jack Belzer, U. of Pittsburgh
Harold Borko, U.C.L.A.
Anindya Bose, Pratt Institute
William Cameron, U. of Western Ontario
Margaret Chisholm, U. of Maryland
Anthony Debons, U. of Pittsburgh
Arthur Elias, BIOSIS (formerly with Informatics, Inc.)
Donald Ely, U. of Syracuse
Bernard Fry, Indiana U.
Anand B. Gupta, U. of Pittsburgh
J. Phillip Immroth, U. of Pittsburgh
Allen Kent, U. of Pittsburgh
John Kronebusch, U. of Pittsburgh
Thomas Mott, Jr., Rutgers U.
John Murdock, Battelle Memorial Inst.
Alan Rees, Case-Western Reserve U.
Frank Sessa, U. of Pittsburgh
Vivian Sessions, City College of N.Y.
Joshua I. Smith, ASIS
C. Walter Stone, JMARC Inc.
James Williams, U. of S. Carolina
Melba Williams, U. of Pittsburgh

Appendix B: Schools Participating in Questionnaire Analysis

School	First Questionnaire 1968	Second Questionnaire 1972
Auburn University		X
Arizona State University		X
Bowling Green State University		X
California State University		X
Case Western Reserve University	X	X
Chattanooga State Technical Institute		X
City University of New York		X
Clarion State College	X	X
Cornell University		X
Dalhousie University		X
Drexel University	X	X
East Carolina University		X
East Tennessee State University	X	X
Emory University		X
Florida Atlantic University		X
Florida State University	X	X
George Peabody College of Teachers	X	X
Georgia Institute of Technology	X	X
Harvard University		X
Illinois Institute of Technology		X
Indiana University	X	X
Iowa State University		X
Kent State University		X
Lehigh University	X	
McGill University		X
Northern Illinois University		X
Ohio State University		X
Point Park College		X
Pratt Institute	X	X
Queens College (CUNY)		X
Rosary College	X	X
Rutgers University	X	X
St. Cloud State College	X	X
San Jose State College	X	
Simmons College		X
Southern Connecticut State College	X	X
State University of New York (Albany)	X	X
State University of New York (Buffalo)	X	X
Stanford University		X
Syracuse University	X	X
Texas Woman's University	X	
University of Alberta		X
University of British Columbia	X	X
University of California (Berkeley)	X	X
University of California (L.A.)	X	X
University of Chicago	X	X
University of Colorado	X	X
University of Dayton	X	Discontinued
University of Denver	X	X
University of Guam		X
University of Illinois	X	X
University of Iowa		X
University of Kentucky		X
University of Maine	X	
University of Maryland	X	X
University of Michigan	X	X
University of Minnesota		X
University of Missouri (Columbia)	X	X
University of Missouri (Rolla)	X	X
Université de Montreal	X	X
University of North Carolina		X
University of Oklahoma	X	
University of Oregon	X	X

University of Portland		X	
University of Pittsburgh		X	X
University of Rhode Island		X	
University of Southern California		X	X
University of Southern Mississippi			X
University of Tennessee			X
University of Texas			X
University of Toronto			X
University of Washington		X	
University of Western Ontario		X	X
University of Wisconsin (Madison)		X	X
University of Wisconsin (Milwaukee)		X	X
Washington State University		X	
Washington University			X
Western Illinois University			X
Western Kentucky University			X
Western Michigan University		X	X
Total	80	45	70

There were 35 schools in both studies.

Appendix C:

Textbooks: Authors and Titles mentioned in the Questionnaire

	Frequency
1. Akers, Susan G.: Simple Library Cataloging. Rev. 5th ed. Metuchen, NJ: Scarecrow Press (1969).	1
2. Ames, William F.: Numerical Methods for Partial Differential Equations. NY Barnes & Noble (1969).	2
3. Arbib, Michael: Theories of Abstract Automata, ref. ed. Englewood Cliffs NJ: Prentice-Hall (1969).	1
4. Arnold, Robert R.: Introduction to Data Processing New York: Wiley (1966).	1
5. Artandi, Susan: An Introduction to Computers in Information Science. 2nd ed. Metuchen, NJ: Scarecrow Press (1972).	9
6. Ash, R.B.: Information Theory. New York: John Wiley (1965).	1
7. Ashby, W. Ross: Introduction to Cybernetics (Repr. of 1956 ed.) New York. Barnes & Noble (1968).	1
8. Banathy, Belah: Instructional Systems. Belmont, CA: Fevoin Pub. (1968).	1
9. Bartee, Thomas C.; Digital Computer Fundamentals. 3rd ed. NY: McGraw-Hill (1972).	1
10. Bates, Frank and Douglas, Mary L.; Programming Language One. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall (1970).	
11. Bauer, C.: IITRAN/360: Self Instruction Manual and text. Reading, MA: Addison-Wesley (1968).	1
12. Becker, Joseph & Hayes, Robert M.; Information Storage and Retrieval. NY: John Wiley (1963).	2
13. Becker, Joseph: Conference on Interlibrary Coop. and Information Networks, Proceedings. Chicago: American Library Assoc. (1971).	1
14. Bell, C.G. and Newell, A.: Computer Structures Readings & Examples. NY Mc-Graw-Hill (1971).	5
15. Bell, David Arthur: Information Theory and Its Engineering Applications. 2nd ed. NY: Pitman (1956).	1
16. Berelson, Bernard and Janowitz, M.; Reader in Public Opinion & Communication. 2nd ed. Riverside, NJ Free Press (1966).	2
17. Berztiss, A.T.: Data Structures: Theory & Practice. NY: Academic Press (1971).	2
18. Blumenthal, Sherman S.; Management Information Systems. Englewood Cliffs, NJ: Prentice-Hall (1969).	1
19. Bohl, Marilyn; Information Processing Palo Alto, CA: Science Research Associates, IBM (1971).	1
20. Booth, T.L.; Digital Networks and Computer Systems. NY: John Wiley (1971).	1
21. Borko, Harold; Automated Language Processing. NY: John Wiley (1967).	1
22. Bourne, Charles P.: Methods of Information Handling. NY: John Wiley (1963).	2
23. Bower, James B., et al. Financial Information Systems. Rockleigh, NJ Allyn & Bacon (1969).	2
24. Bradshaw, Charles I. et al; Using the Library. Provo, Utah: Brigham Young Univ. Press (1971).	
25. Brix, V.H. You are a Computer: Cybernetics in Everyday Life. Buchanau, NY Emerson Books (1970).	1
26. Brown, James Wilson and Fred F. Harulewood. AV instruction: technology, media, and methods. 4th ed. NY McGraw-Hill (1973).	1
27. Bruyn, S.; The Human Perspective in Sociology: The Methodology of Participant Observation. Englewood Cliffs, NJ: Prentice-Hall (1966).	1
28. Buchholz, Werner, Planning A Computer System, NY: McGraw-Hill (1962).	1
29. Busacker, Robert G. and Saaty, T.; Finite Graphs & Networks: An Introduction with applications. NY: McGraw-Hill (1965).	1
30. Cadow, H.; OS/360 Job Control Language	1
31. Campbell, Donald T. and Stanley, Julian C.: Experimental & Qiasi-experimental Designs for Research. Chicago: Rand McNally (1966).	2
32. Carlsen, G. Robert; Books and the Teenage Reader; A guide for Teacher, Librarians and Parents. rev. ed. NY: Harper & Row (1972).	1
33. Caruth, Donald L. and Rachel, Frank M. eds., Business Systems: Articles Analysis and Cases. San Francisco: Canfield Pr. (1972).	1
34. Chapin, Ned; Computers: A Systems Approach. NY: van Nostrand Reinhold (1971).	1
35. Chapman, Edward A.; Library Systems Analysis Guidelines. NY: John Wiley, n.d.	4
36. Chaumier, Jacques; Les Techniques Documentaries, Paris: Presses Universaires de France (1971).	1

37. Churchman, C. West; The Systems Approach. NY: Dell Publishing (1969). 3
38. Collinson, Robert: Abstracting and Abstract Services: Santa Barbara, CA. ABC-Clio (1971). 1
39. Conant. Pap. 1.95; Two Modes of Thought. NY: Simon & Schuster, M.D. 1
40. Cooper, Leon N. and Steinberg, David; Introduction to Methods of Optimization. Philadelphia: W.B. Saunders (1970). 1
41. Couger, J. Daniel and Shannon, Loren E.; FORTRAN IV: A Programmed Instruction Approach. rev. ed. Homewood, IL: Richard D. Irwin (1972). 1
42. Cress, P. et al; FORTRAN IV with WATFOR and WATFIV. Englewood Cliffs, NJ: Prentice-Hall (1970). 1
43. Daniels, Alan and Yeates, Donn D.; Basic Training in Systems Analysis, London: Pitman (1969). 2
44. Davis, Gordon B.; An Introduction to Electronic Computers. 2nd ed. NY: McGraw-Hill (1971). 2
45. Davis, Gordon B.; Computer Data Processing. 2nd ed. NY: McGraw-Hill (1973).
46. Dearden, John, et al. McFarlen, F. Waman, and Zani, William M.; Managing Computers Based Information Systems, Homewood, IL: Richard D. Irwin (1971). 2
47. De Greene, Kenyon B.; Systems Psychology. NY: McGraw-Hill (1970). 1
48. Delong, Howard; A Profile of Mathematical Logic. Reading, Man.: Addison-Wesley Pub. (1970). 1
49. Dexter, Lewis A. and White, David M.: People, Society and Mass Communications. Riverside, NJ: Free Press (1964). 2
50. Dippel, Gene and House, Wm. C.; Information Systems; Data Processing and Evaluation, Glenview, IL: Scott Forseman (1969). 1
51. Donovan, John; Systems Programming. NY McGraw-Hill (1972). 3
52. Dorf, Richard C.; Introduction to Computers and Computer Science. San Francisco: Boyd & Fraser. Pub. (1972). 1
53. Duda, R.O. & Hart, Peter; Pattern Classification and Scene Analysis. NY: John Wiley (1973). 1
54. Ebert, Myrl; An Introduction to the Literature of the Medical Sciences, 3rd ed. Chapel Hill: University of North Carolina Student stores (1970). 1
55. Elias, Arthur; Key Papers in Information Science. Washington, DC: American Society for Information Science (1971). 1
56. Elliott, C. Orville; Programmed Learning Aid for Introduction to Data Processing Homewood, IL: R.D., Irwin (1970). 1
57. Elliott, C. Orville and Wasley, Robert S.; Business Information Processing Systems, rev. ed. Homewood, IL: Richard D. Irwin (1968). 2
58. Festinger, Leon & Katz, Daniel; Research Methods in the Behavioral Sciences. NY: Holt, Rinehart & Winston (1954). 1
59. Fike, C.T.: PL/1 For Scientific Programmers. Englewood Cliffs, NJ: Prentice-Hall (1970). 1
60. Fischer, David; Historians Fallacies. New York: Harper & Row Pub. (1969). 1
61. Flores, Ivan; Data Structure and Management. Englewood Cliffs, NJ: Prentice-Hall (1970).
62. Forsythe, George and Moler, C.; Computer Solution of Linear Algebraic Systems. Englewood Cliffs, NJ: Prentice-Hall (1967). 1
63. Forsythe, Alexandra I., et al. Computer Science: A First Course, NY: John Wiley (1969). 4
64. Forsythe, Alexandra I.; Computer Science: Basic Language Programming. NY: John Wiley (1970). 2
65. Foskett, A.C.; The Subject Approach to Information. 2nd ed. Hamdens Conn.: Shoe String Press (1971). 5
66. Favret, Andrew G.; Introduction to Digital Computer Principles & Applications New York: Van Nostrand Reinhold (1965). 2
67. Franzblau, Abraham N.; Primer of Statistics for Non-Statisticians. NY: Harcourt Brace Jovanovich, M.D. 1
68. Freund, John E.; Statistics; A First Course. Englewood Cliffs, NJ Prentice-Hall (1970).
69. Gear, C.W.; Numerical Initial Value Problems in Ordinary Diff. Equations. Englewood Cliffs, NJ: Prentice-Hall (1971). 3
70. Gerald, Curtis F.; Applied Numerical Analysis, Reading, MA: Addison-Wesley (1970). 1
71. George, F.J.; The Brain as a Computer. 2nd ed. Elmsford, NY: Pergamon Press (1973). 1
72. Gerlach, Vernon S. and Ely, Donald P.; Teaching and Media: A systematic Approach. Englewood Cliffs, NJ: Prentice-Hall (1970). 1
73. Goldhor, Herbert: An Introduction to Scientific Research in Librarianship. Chicago: University of Ill. Library Science (1972). 1
74. Goldhor, Herbert: Research Methods in Librarianship: Measurement and Evaluation. Chicago: University of Ill. Library Science (1968). 1
75. Gordon, Geoffrey; System Simulation. Englewood Cliffs, NJ: Prentice-Hall (1969). 1
76. Gries, David; Compiler Construction for Digital Computing. NY: John Wiley (1971). 5
77. Griswald, R., et al: The SNOBOL Four Programming Language. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall (1971). 6
78. Gross, Jonathan L. and Brainerd, Walter S.; Fundamental Programming Concepts, NY: Harper & Row (1972).
79. Gschwind, Hans W.; Design of Digital Computers. NY: Springer-Verlag (1967). 2
80. Gupta, R.; Electronic Information Processing. NY: Macmillan (1971). 1
81. Hanson, Norwood R.; Patterns of Discovery: An Inquiry into the Conceptual Foundations of Science. NY: Cambridge University Press (1958-1965). 1
82. Hayes, Robert and Becker, Joseph: Hand-

book of Data Processing for Libraries. NY: John Wiley (1970). 17

83. Heiliger, edward M. and Paul B. Henderson; Library Automation; Experience, Methodology and Technology of the Library as an Information System. NY: McGraw-Hill (1971). 2

84. Hein, Leonard W.; Contemporary Accounting and the Computer. Eninco, CA Dickerson Publ (1969). 1

85. Hempel, Carl G.; Philosophy of Natural Science. Englewood Cliffs, NJ: Prentice-Hall (1966). 1

86. Hempel, Carl G.; Fundamentals of Concept Formation in Empirical Science. Chicago: University of Chicago Press (1952). 1

87. Hermes, Hans; Enumerability, Decidability, Computability: An Introduction to the Theory of Recursive Functions. 2nd ed. NY: Springer-Verlag (1969). 1

88. Hicks, Warren B. and Tillin, Alma M.; Developing Multi-Media Libraries New York: Bowker (1970). 1

89. Hoel, Paul G.; Elementary Statistics. 3rd ed. NY: John Wiley (1971). 2

90. Hopcroft, John E. and Ullman, Jeffrey D.; Formal Languages and the Relation to Automata. Reading, MA: Addison-Wesley (1969). 8

91. Hudson, Liam; Contrary Imaginations: A Psychological Study of the English School Boy. NY: Schocken Books (1966). 1

92. Hudson, Liam; The Ecology of Human Intelligence. Gloucester, MA.: Smith Peter, Publisher, N.d. 1

93. Hughes, J.; Programming the IBM 1130. NY: John Wiley (1969). 2

94. Hull, T.E. and Day, D.D.: Computers and Problem Solving. Reading, MA: Addison-Wesley (1969). 1

95. Husson, Samir S.: Microprogramming: Principles and Practices. Englewood Cliffs, NJ Prentice-Hall (1969). 1

96. Ingerman, Peter Z.; A Syntax-Oriented Translator. NY: Academic Press (1966). 1

97. Iverson, Kenneth E.; Programming Language. NY: John Wiley (1962). 2

98. Jacobi, Jolande; The Psychology of C.G. Jung. New Haven, CN. Yale U. Press (1963).

99. Jacobs, Harold R.; Mathematics, A Human Endeavor: A textbook for Those Who Think They Don't Like the Subject. San Francisco: W.H. Freeman (1970). 1

100. Jahoda, Gerald; Information Storage and Retrieval for Individual Researchers. New York: John Wiley (1970). 1

101. Katz, W.A.; Introduction to Reference Work, 2 Vols. 2nd ed. NY: McGraw-Hill (1973). 1

102. Katzan, Harry; Computer Organization and the System 370. NY: Van Nostrand Reinhold (1971). 1

103. Keller, Herbert Bishop: Numerical Methods for Two-Point Boundary Value Problems Waltham, MA Blaisdell (1968). 1

104. Kemp, Jerold E.; Planning and Producing Audiovisual Materials. Scranton, PA: Chandler Pub. (1968). 1

105. Kent, Allen; Information Analysis and Retrieval. New York: Becker & Hayes (1971). 1

106. Kent, Allen: Textbook on Mechanized Information Retrieval. NY: Interscience Publishers (1966). 3

107. Kent, Allen and Canter, John; Specialized Information Centers. Washington: Spartan Books (1965). 2

108. Kerlinger, Frederick N.; Foundations of Behavioral Research: Educational Psychological and Sociological Inquiry. 2nd ed. NY, Holt, Reinhart and Winston (1973). 1

109. Klir, Jiri and Valach, Miroslav; Cybernetic Modelling. London, Iliffe (1967). 1

110. Knight, G. Norman, ed. Training in Indexing. Cambridge, MA, MIT Press (1969). 1

111. Knuth, Donald E.; Art of Computer Programming, Vol. I: Fundamental Algorithms Reading, MA, Addison-Wesley (1968). 8

112. Knuth, Donald E.; Logic and Algorithms with Applications to the Computer and Information Science (By R.R. Korfhage, NY Wiley (1966)).

113. Lancaster, Frederik Wilfrid; Information Retrieval Systems, NY, Wiley (1968). 7

114. Langendoen, D.T.; The Study of Syntax: The Generative-Transformational Approach to the Structure of American English NY Holt, Rinehart & Winston (1969). 2

115. Lee, R.M.: A Short Course in FORTRAN TV Programming: Based on The IBM operating system/360, basic Fortran IV. NY, McGraw-Hill (1967). 2

116. Leonard, Harry S.; Principles of Reasoning: An introduction to logic methodology and the theory of signs., Magnolia, MA, Peter Smith. 1

117. Laden, H.N. and Gildersleeve, T.R.: System Design for Computer Applications NY, Wiley (1963). 1

118. Lefkovitz, David; File Structures for On-Line Systems Rochelle Park, NJ, Hayden Book Co. (1969). 4

119. Liu, D.L.; Introduction to Applied Combinatorial Mathematics. NY McGraw-Hill (1968). 1

120. McCracken, Daniel D. and Garbassi, Umberto; A Guide to COBOL Programming. 2nd ed. NY Wiley (1970). 7

121. McCracken, Daniel D.; A Guide to FORTRAN IV Programming 2nd ed. NY, Wiley (1972). 1

122. McCluskey, E.J.; Introduction to the Theory of Switching Currents. NY, McGraw-Hill (1965). 1

123. McMillan, Claude and Conzalez, Richard F.; Systems Analysis. Homewood, IL Richard D. Irwin Co. (1968). 2

124. Maccoby, Eleanor E., et al; Readings in Social Psychology. NY, Holt, Rinehart & Winston, 3d ed. (1958). 2

125. Mann, Margaret; Introduction to Cataloguing

and the Classification of Books, 2nd ed. Chicago, American Library association (1943). 2

126. Marcuse, H.; Eros and Civilization: A Philosophical Inquiry into Freud (pap. 1.65) Boston, Beacon Press (1965). 1

127. Markuson, Barbara E.; Guidelines for Library Automation. Santa Monica, CA (1972). 1

128. Martin, James; Telecommunications and the Computer Englewood Cliffs, NM, Prentice-Hall (1969). 1

129. Mott, Thomas H., Artandi, Susan, and Stuminger, Lenn: Introduction to PL/1, Programming for Library and Information Science, NY, Academic Press (1972). 1

130. Maurer, Ward Douglas; Programming: An Introduction to Computer Language and Techniques, San Francisco, Holden-Day (1968). 3

131. Meadow, Charles T.; Man Machine Communication NY, Wiley (1970). 1

132. Meadow, Charles T.; The Analysis of Information Systems 2nd ed., Wiley (1973). 3

133. Meister, David; Human Factors: Theory and Practice. NY, Wiley (1971). 1

134. Meltzer, Morton F.; The Information Center: Management's Hidden Asset NY, American Management Assos. (1967). 1

135. Mendelson, Elliott; Introduction to Mathematical Logic NY, Van Nostrand Reinhold (1964). 2

136. Miller, George A.; Psychology of Communication NY, Penguin Books (1969) (Pelican) 1

137. Minsky, Marvin; Computation: Finite and Infinite Machines. Englewood Cliffs, NJ Prentice-Hall (1967). 2

138. Morse, Philip, M. (ed.): Operations Research For Public Systems. Cambridge, MA, MIT Press (1967). 1

139. Murach, Mike; Standard COBOL. Chicago, Science Research Associates (1971). 3

140. Murdick, Robert G. and Ross, Joel E.; Information Systems for Modern Management Englewood Cliffs, Prentice-Hall (1971). 1

141. Naylor, Thomas H., et. al.; Design of Computer Simulation Experiments, Durham, NC, Duke University Press (1969). 1

142. Neidorf, Robert: Deductive Forms: An Elementary Logic NY, Harper-Row (1967). 1

143. Nievergett, Jurg & Faiman, Michael: Pertinent Concepts in Computer Graphics. Chicago; University of Ill. Press (1969). 1

144. Nilsson, Nils J.; Learning Machines: Foundations of Trainable Pattern-Classifying Systems. NY McGraw-Hill (1965). 1

145. Nilsson, Nils J.; Problem Solving Methods in Artificial Intelligence NY, McGraw-Hill (1971). 3

146. Optner, Stanford L.; Aystems Analysis for Business and Industrial Problem Solving Englewood Cliffs, NJ, Prentice-Hall (1965). 1

147. Organ, Troy W.; The Art of Critical Thinking. Boston, Houghton Mifflin (1965). 1

148. Overmyer, Lavahn; Library Automation: A Critical Review. U.S. Office of Education, Bureau of Research, Washington (1969). 1

149. Parl, Boris; Basic Statistics, NY, Doubleday (1967). 1

150. Pennington, Ralph H.: Introductory Computer Methods and Numerical Analysis, 2nd ed. NY, Macmillan (1970). 1

151. Pepinsky, H.B.; People and Information. Elmsford, NY, Pergamon Press (1970). 1

152. Polanyi, Michael; Personal Knowledge: Towards a Post-Critical Philosophy Chicago, University of Chicago Press (1958). 1

153. Pollack, Seymour V. and Sterling, Theodore D; A Guide to PL/1 NY, Holt, Rinehart and Winston (1970). 3

154. Prince, Thomas R.; Information Systems for Management Planning and Control. Rev. ed. Homewood, IL Richard D. Irwin, Inc. (1970). 1

155. Price, Derek John deSolla; Little Science, Big Science NY, Columbia University Press (1963). 1

156. Proshansky, H.M.; Environmental Psychology: Man and His Physical Setting, NY, Holt, Rinehart & Winston (1970). 3

157. Raiffa, Howard; Decision Analysis: Introductory Lectures on Choices Under Uncertainty. Reading, MA, Addison-Wesley (1968). 1

158. Ralston, Anthony: A First Course in Numerical Analysis NY, McGraw-Hill (1965). 2

159. Roberts, Edward Graham; The Literature of Science and Engineering. 2nd ed. Atlanta. School of Information Science, Georgia Institute of Technology (1969). 2

160. Rogers, E. and Shoemaker, F.; Communication of Innovations. Riverside, NJ, Free Press (1971). 1

161. Rogers, Hartley, Jr.; Theory of Recursive Functions and Effective Computability NY, McGraw-Hill (1967). 4

162. Rosenfeld, A.; Picture Processing By Computer, NY, Academic Press (1969).

163. Roszak, T. Theodore; The Making of a Counter Culture. NY, Doubleday (1969). 1

164. Saettler, P.; A History of Instructional Technology. NY, McGraw-Hill (1968). 1

165. Saloman, A.; Mathematical Theory of Automata: Proceedings, Vol. 12. [V. 12 ed. by J. Fox] NY, Wiley (1963). 1

166. Salton, Gerald; Automatic Information Organization and Retrieval. NY, McGraw-Hill (1968). 1

167. Sanders, Donald H.; Computers and Management. NY, McGraw-Hill (1970). 1

168. Sanders, Donald H.; Computers in Business. NY, McGraw-Hill (1972). 2

169. Saracevic, Tefko; Introduction to Information Science, NY, Bowker (1970). 2

170. Sayers, Anthony, ed.: Operating Systems Survey. Phila. Auerbach Pubs. (1971). 1

171. Sayers, W.C. and Maltby, Arthur: A Manual of Classification for Librarians. 4th ed London; Dentsch (1967). 1

172. Schmidt, J.W.; Simulation and Analysis of

Industrial Systems, Homewood, IL, Richard D. Irwin, Inc. (1970). 1
173. Schramm, Wilbur; Science of Human Communication Seranton, PA; Basic Books, Inc. (1963). 1
174. Schramm, Wilbur; Mass Communications. 2nd ed. Urbana, University of Illinois Press (1960). 2
175. Schramm, Wilbur and Roberts, Donald F; Process and Effects of Mass Communication Rev. ed. Urbana, University of Illinois Press (1971). 2
176. Sellitz, Claire; Research Methods in Social Relations. Rev. ed., NY, Holt, Rinehart and Winston (1959). 1
177. Slater, Phillip E.; The Pursuit of Loneliness: American Culture at the Breaking Point. Boston, Beacon Press (1971). 1
178. Smith, Gloria and Robert S. Meyer; Library Uses of Computers: An Introduction. NY, Special Libraries Association (1969). 1
179. Spencer, Donald D.: A Guide to BASIC Programming: A Time-Sharing Language. Reading, MA, Addison-Wesley (1970). 1
180. Squire, Enid; The Computer; An Everyday Machine. Addison-Wesley (1972). 1
181. Starbuck, William H. and Dutton, John M.; Computer Simulation of Human Behavior, NY, Wiley (1971). 1
182. Steinhart, Robert F. and Plooack, Seymour V.; Programming the IBM S/360 NY Holt, Rinehart & Winston (1970). 1
183. Stone, Harold S.; Introduction to Computer Org. and Data Structures NY, McGraw-Hill (1972). 2
184. Struble, George W.: Assembler Language Programming: The IBM S/360 Reading, MA, Addison-Wesley (1969). 2
185. Trakhtenbrot, Boris A.; Algorithms and Automatic Computing Machines Lexington, MA D.C. Health. Co. (1963). 1
186. Travers, Robert M.; Man's Information System: A Primer for Media Specialists and Educational Technologists NY, Chandler Pub. Co. (1970). 1
187. Erickson, Carlton W.; Fundamentals of Teaching with Audiovisual Technology 2nd ed., NY Macmillan (1972). 1
188. Lyons, John; Introduction to Theoretical Linguistics. London, Cambridge University Press (1968). 1
189. Hare, Van C., Jr.; Systems Analysis: A diagnostic Approach, NY, Harcourt Brace, Jovanovick (1967). 1
190. Van Fraassen, B.C.; Formal Semantics and Logic NY Macmillan (1971). 2
191. Weissman, Clark; LISP One–Point–Five Primer Belmont, CA, Dickenson (1967). 1
192. Vickers, F.D.; FORTRAN IV: A Modern Approach, NY, Holt, Rinehart & Winston (1970). 1
193. Vickery, Brian C.: Technique of Information Retrieval, Hamden, CT Shoestring Press (1970). 2
194. Vickery, Brian C.; On Retrieval System Theory, 2nd ed. Hamden, CT, Shoestring Press (1965). 2
195. Wagner, Harvey M.; Principles of Operations Research With Applications of Managerial Decisions Englewood Cliffs, NJ, Prentice-Hall (1969). 1
196. Watson, Richard W.; Time-Sharing Design Concepts NY, McGraw-Hill (1970). 3
197. Watson, James D.; Double Helix, NY, Atheneum (1968). 1
198. Webb, Eugene; Unobstructive Measures: Nonreactive Research in Social Sciences Chicago, Rand McNally & Co. (1966). 1
199. Weisman, Herman M.; Information Systems, Services and Centers NY, Wiley (1972). 1
200. Wheeler, Margaret Thorne; Indexing Principle, Rules and Examples, Albany, University of the State of New York (1920). 2
201. Wilson, Edgar B.; Introduction to Scientific Research, NY, McGraw-Hill (1952).
202. Wiley, John and Sons; COBOL Operating Systems, IBM S/360, U.S.A. Standard 2
203. Wofford, Azile; The School of Library at Work NY, Wilson (1959). 1
204. Yasuhara, Ann; Recursive Function Theory and Logic NY, Academic Press (1971). 1
205. Kohavi, Zvi: Switching and Finite Automata Theory. NY, McGraw-Hill (1970). 1
206. Yngve, Victor H; Computer Programming with COMIT II. Cambridge MA, MIT press (1972). 1