The Application of Micro-Computers in Information, Documentation and Libraries
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Development and application of micro-computer software in a postgraduate course for information transfer and management

Rainer Kuhlen

University of Constance
Department of Information Science
D-7750 Konstanz Mailbox 5560

As of fall 1983 a post-graduate program in information science is being offered at the University of Constance. The program is aimed at information transfer and management and emphasizes the development and application of information software. Students are encouraged to become acquainted with appropriate information and communication technologies. This paper concentrates on teaching experience with micro-computer based courses such as information retrieval, information linguistics, office automation. In addition, this paper discusses how to building up and running an information science micro-electronic laboratory with time-sharing micros and personal computers.

1. Postgraduate course in information science at the University of Constance

Information science at the University of Constance started its work as of fall 1980. Since then we have built up a research group that conducts projects mainly financed by public sponsors[1], runs a four semester post-graduate course in information science and a modern, well-equipped, mainly micro-computer based EDP-laboratory.

Information science in West-Germany on a university level is still, and possibly will always be, a small discipline[2]. Full curricula in information science are offered only at four locations, at the universities of Berlin, Düsseldorf, Saarbrücken, and Constance. But, of course, there is much more information science research and teaching going on in West-Germany: for example almost every computer science department deals with information science topics, and departments of psychology, linguistics, and economics are increasingly coming to realize the importance of information processing from psychological, linguistic, and economic points of view, respectively.

In this paper I'd like to concentrate on some curricular aspects of technology-dependent courses in information science. First some statistical information about our curriculum.

As one can see from the statistics (cf. Tab.1) we only accept a very limited number of students (about 25 students beginning in the fall term), who must be highly qualified in their first field

of study. The term "post-graduate" does not mean - as is sometimes the case in American post-graduate courses - that the students already have academic or professional experience in information science or practice. Our students at the beginning are in general real freshmen in information science and have academic backgrounds from almost all fields (cf. Tab.2). Information science at the University of Constance is a genuine scientific melting pot, as is the case in professional information environments as well.

We hold that the combination of solid knowledge in a certain scientific or professional field and of information science methodology is extremely helpful if not necessary to meet the actual and future professional needs of information transfer specialists and information managers. Information service can hardly be accepted without domain-specific knowledge and experience. And the same goes for information management, which should be based on profound knowledge of organizational and economic theory acquired in a first field of graduate study.

It may be thought that there is a danger in this constellation that our students are too old as job beginners. An average program of graduate study ending with a degree in Germany lasts in general about 5 years, and with the additional 2 years in information science, these students have indeed a double academic background and are at least 27 years old. So far, however, this has not turned out to be a disadvantage, none of our students have problems finding an appropriate job. Indeed we have problems keeping them off the market until they have finished their degree. The demand for well-trained or even only partially-trained people in the field of information and communication technology is steadily increasing in countries like West-Germany.

Let me biefly describe the two major fields we concentrate on.

	1st year WS82/83	2nd year WS83/84	3rd year WS84/85	4th year WS85/86
total	16	22	22	37
Constance	11	8	9	12
other universities	5	14	13	25

Tab. 1 Students' statistics

	1st year WS82/83 (16)	2nd year WS83/84 (21) *	3rd year WS84/85 (20) **	4th year WS85/86 (34)
mathematics, physics computer science	6	6	4	10
biology, chemistry	2	–	2	2
administration science, law, economics	5	10	9	10
social sciences	3	2	1	5
other disciplines				
psychology		1	1	
medicine		1		
library science		1		
history			1	
French literature			1	
German literature				4
architecture				1
engineering (machine)				1
geography				1

Tab. 2 Students' academic background
(* 1 student unidentified; ** 2 students unidentified)

1.1 Information transfer (counselling/brokering)

Information transfer ("Informationsvermittlung") is the professional usage and tranformation of resources and products of the information market for the purpose of satisfying information needs. The increasing computerization of information services, originally designed to assist end-users, complicates information work and consequently increases the demand for professional information people. Information transfer plays an important role among the different information activities, as can be seen from Fig.1.

The information transfer specialist ("Informationsvermittler") ascertains the exact information requirements of the end-user and selects the relevant information from the range of information systems and other information resources[3] and passes it on to the user in a comprehensible and usable form[4] (cf. Fig.1).

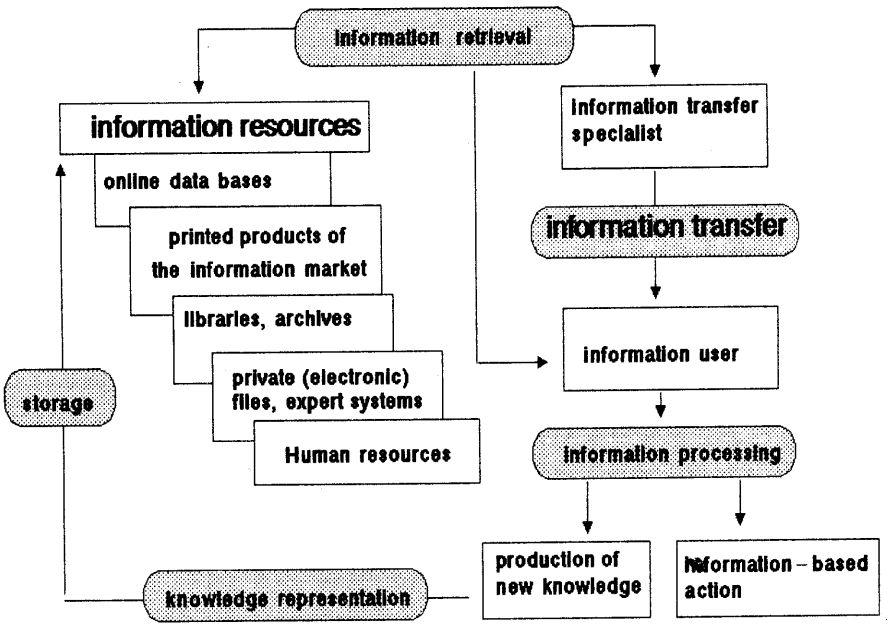

Fig. 1 Information transfer in the context of information activities

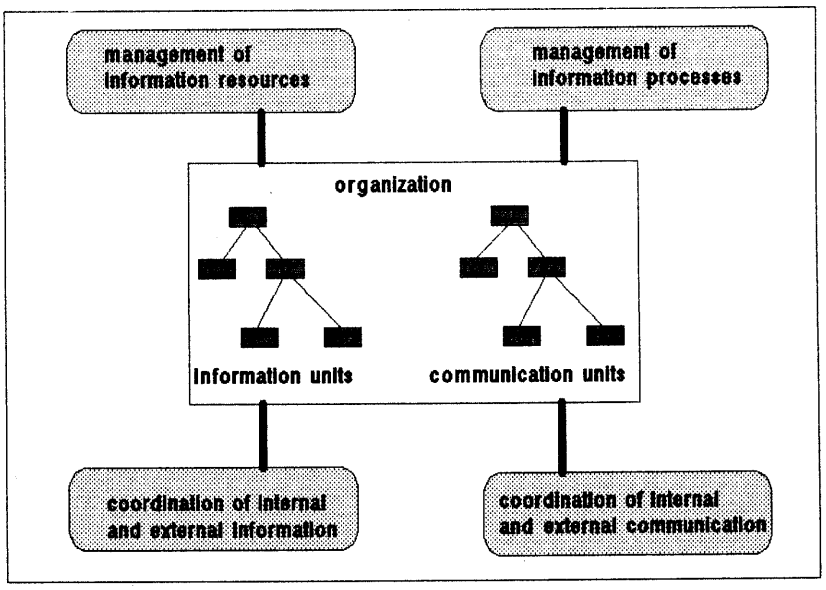

Fig. 2 Information management as coordination of information resources and processes (communication)

1.2 Information management

Information management is the organization of information in an organizational environment. It is becoming increasingly important for institutions of all kinds (both public organizations and private enterprises) to professionally organize the existing supply of know-how and technology. Information is thus comparable to other resources, such as people, finance, raw material. The situation of information management which can be understood as the coordination of internal and external information resources is shown in Fig.2.

1.3 Qualification profiles

In accordance with professional demands we believe that information transfer specialists and managers, respectively, should have the qualification profiles which are shown in Tab.3.

1.4 Structure of courses

To acquire such a profile and to be well prepared for the demands of the job market we require[5] that our students take the courses shown in Tab.4

2. Objectives of technology/micro-computer-dependent courses

In the following I'd like to concentrate on technology- or micro-computer dependent courses. But this should not lead to the conclusion that computer training is the main objective of our curriculum. Information scientists are responsible for the solution of information problems in social and/or organizational contexts and with respect to individual (cognitive) information processing capacities or with respect to political/legal and economic constraints. Information work is not only a function of technology but depends on a wide variety of factors[6]. However, this must be the topic of another paper.

Information scientists must take advantage of a whole range of information and communication technologies which are available on the information market. They use technology, and - to a certain degree - they develop new software, but normally, if they are in a professional and not a scientific environment, they apply commercial software and sometimes transform it according to specific end-users' needs.

The decision as to how much computer science knowledge an information transfer specialist or an information manager should learn during his study is still an open question. Some people believe that the increase in commodity and user-friendliness of commercial software packages will decrease the amount of necessary hard computer science knowledge. On the other hand, the increasing complexity of integrated packages and the rapid change in technology demand an abstract level of knowledge in order to be flexible with respect to new developments.

Let me demonstrate the varying degree of technical demands with an example from the information retrieval field. As can be seen from Fig.3 there is a wide variety of different curricular activities in information retrieval, which require different skills.

Qualification profiles for information transfer specialists and information managers

(B = Basic I = Intensive)

Field of qualification	Subject	Information transfer	Information management
I. Methods of investigation / analysis / design implementation	– techniques of investigation, (interview, inquiry, obervation, experiment)	B	I
	– techniques of analysis and design (descriptive and predictive statistics)	B	I
	– techniques of analysis and design (system analysis, system design)	B	I
	– techniques of organizational implementation	B	I
II. Methodical and technical fundamentals of information systems	– database methods	I	B
	– methods of structured programming	B	B
	– information linguistics	B	B
III. Use of information systems	– information services	I	B
	– information retrieval systems	I	B
	– intelligent information systems	B	I
	– office information and communication systems	B	I
IV. Content analysis/ knowledge representation	– techniques of intellectual content analysis (indexing and abstracting rules, documentation languages) knowledge representation languages and inferencing techniques	I	B

Tab. 3.1 Qualification profiles of information transfer specialists and information managers

Qualification profiles for information transfer specialists and information managers (B = Basic I = Intensive)

Field of qualification	Subject	Information transfer	Information management
V. Information presentation	– methods of information presentation and refinement (graphics, texts)	I	B
VI. Psychological and social conditions of information processing	– psychological and cognitive aspects	B	I
	– social and communicative aspects	I	I
	– information and society	B	B
	– information market	I	I
VII. Organizational conditions of information processing	– profitability of information/ cost–benefit analysis	I	I
	– organizational and legal aspects	I	I
	– business mangement science	B	I
	– programme and fincance planning	B	I
	– personell and organizational development	B	I

Tab. 3.2 Qualification profiles of information transfer specialists and information managers

Compulsory courses in the information science curriculum at the University of Constance

	(hours per week) Information Transfer	Information Management
A Methodic fundamentals		
1. Techniques of system analysis, system design and implementation	–	4
2. Methods of structured programming	4	4
3. Information and communication technologies	2	4
4. Database methods	4	–
5. Information linguistics	2	2
B Information systems		
1. Information services	2	–
2. Information retrieval systems	6	4
3. Intelligent information systems	–	2
4. Office information and communication systems	–	4
5. Techniques of intellectual analysis	2	2
6. Methods of information presentation	2	–
C Social context		
1. Psychological and social aspects of information processing	4	4
2. Information and society	2	2
3. Information market	2	2
4. Profitability/economics of information	2	2
5. Organizational and legal aspects of information processing	2	2

Tab. 4 Compulsory courses in information science at the University of Constance

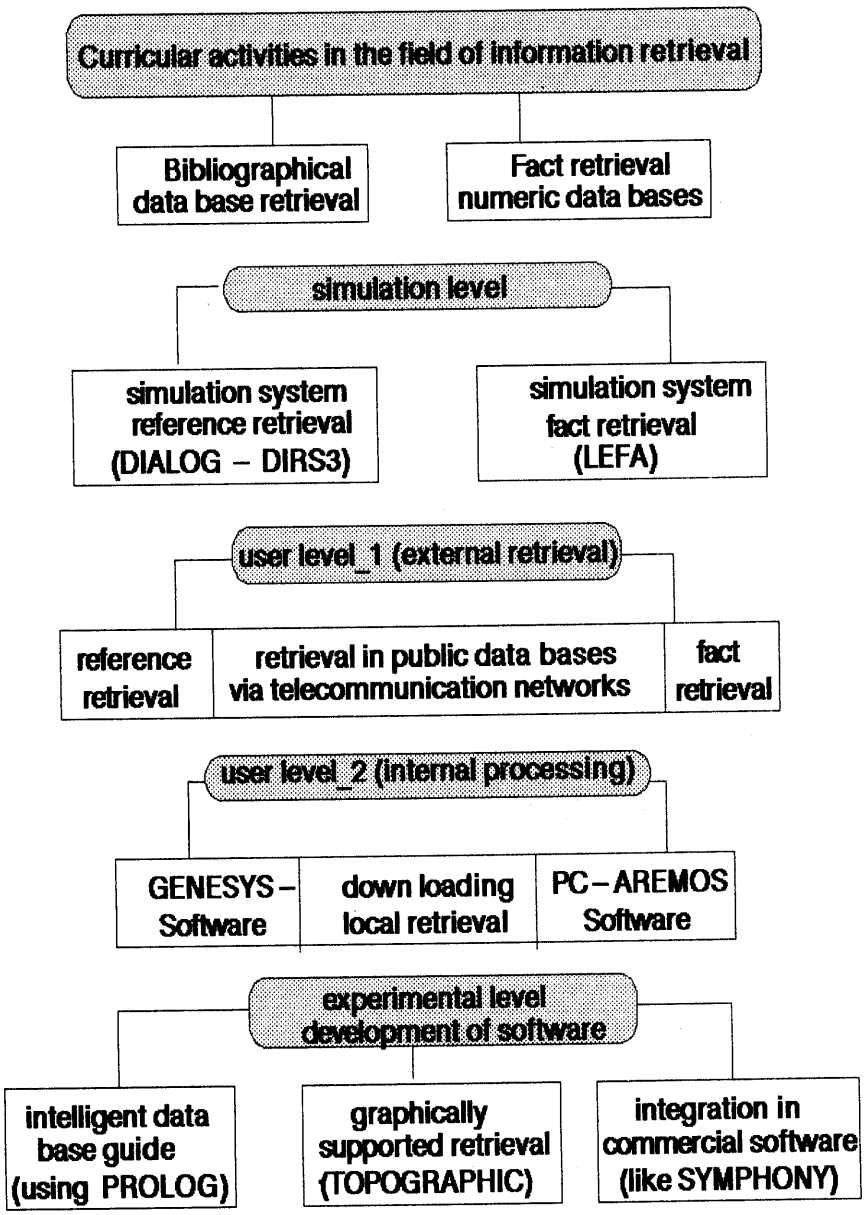

Fig.3 Curricular aspects of information retrieval

To build up and use a private bibliographic data file by adapting commercial PC software (in general based on simple file techniques), the demand for knowledge in computer science is almost zero. The same is true when students learn how to acces and use commercial data banks via telecommunication lines (first in a simulation situation and then in real world one, cf. Fig.3). There are problems enough, for example, with retrieval languages, search strategies, etc., but these are related to computer science only in a very small degree.

The problem changes somewhat when students learn to apply downloading techniques by using commercial software packages such as GENESYS or INFOLOG. The combination of telecommunication, retrieval in remote hosts, and building up a local data base is already a somewhat complex technical activity.

And the demand on computational skills increases noticeably when students learn to build up their own data bases by using relational data base systems such as Informix, which runs under UNIX and is available in our department. The definition of the data model, the implementation of the schema, the definition and realization of retrieval commands, and the construction of flexible print commands with attractive layout designs force the students (and the teachers) to learn a good deal about effective software programming and data administration.

And finally, when advanced students, for the purpose of project or thesis work, write their own software programs, for example, using PROLOG for building up a small expert system or defining a graphics based retrieval interface or writing a routine for a text analysis parser, then the curricular objectives of an information science program are no longer distinguishable from those of computer science. Of course, not all of our students have the background, the skills, and the interest to do such work (especially the information management students are rather more application-oriented than programming- or system-development-oriented), but at least the emphasis on technology and system development is possible, and with respect to further work in our research project, highly desirable.

In general, students learn to apply the software which is available on the market. Rather than only learning how to handle the commands, it is important to understand the principles, and to be able to transform the software which has been designed primarily for commercial work into the information world.

Information scientists and information professionalists can no longer restrict themselves to information (retrieval and data base) systems but must be aware that the advent of integrated and highly complex software packages such as LOTUS1.2.3, SYMPHONY, GEM, WINDOWS, KNOWLEDGEMANN, etc. is a new challenge for information workers.

There are good reasons for the assumption that previous solutions like isolated retrieval workstations are not really attractive or acceptable for end-users. Only if typical information science or documentation work (like retrieval) is an integrated part of other job-related information activities such as communication, calculation, simulation, word processing, or graphics, will it be accepted and used on a larger scale than is the case today.

3. Hardware and software equipment

Information science at the University of Constance, has concentrated, from the very beginning, on experimental work both in study and research. This means that information and communication technology has played an important role.

Although the information science department has local access to the main frame computer of the campus computer center (an IBM-compatible BASF-computer) - and this access is intensively used by the students in programming courses and for editing their own papers - we have decided from the beginning to become computationally independent. Fig.4 gives an overview over the present status of our laboratories.

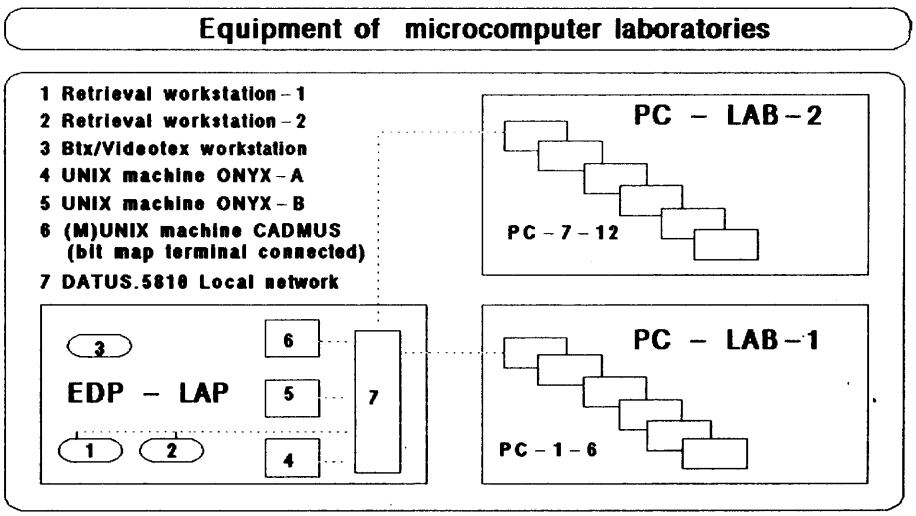

Fig. 4 Microcomputer equipment of the information science department at the University of Constance

As a general objective, our computer equipment had to satisfy the needs of research projects members, of people involved in training, and of adminstrative staff. It might well be possible today to find a hardware solution which would completely concentrate on PCs. In 1981/82, when we started to build up our laboratory, the situation was somewhat different, and therefore we have microcomputers available on two levels, either time-sharing microcomputers on a Unix-basis (ONYX- and CADMUS-machines) and personal computers (mainly MS-DOS-based) usable as stand alone machines but also connected by a local network (DATUS). Everybody can take advantage of the whole gamut of technology available (and each faculty member has either a terminal or a PC or both on his/her desk). The DATUS-net has its own DATUS-P-exit, therefore retrieval

in public data bases and the usage of other telecommunication facilities (bulletin boards, nation- and worldwide mail- and message systems) is possible from each single desk and is becoming increasingly used and useful.

4. Application and development of software in single courses

Let me briefly describe some of the microcomputer-oriented courses of the curriculum (Fig.5 gives on overview of the topics, the objectives and the technology in use) :In course A2 students learn analytical thinking and effective problem solving by structural programming techniques. We use PASCAL as the introductory language and teach MODULA-2 and C for more advanced students. With the advent of more powerful compilers for PCs (eg. Turbo-PASCAL) students are using more and more PCs instead of the main frame of the computer center.

The course A3 "Information and communication technologies" is an obligatory general course intended to introduce students to our laboratory equipment. In general, we expect that students will already have taken an introductory course in data processing and telecommunication (offered by the computer center) because we don't want to be bothered with the elementaries of bits and bytes. (The course A4 and A5 are described in Fig.5.)

A course like B2 has traditionally been in the center of information science curricula because information retrieval has for a long time been (and, in a way, still is today) synonymous with information science. In addition to retrieval in bibliographic data bases (we have access to the main international hosts and collect information from about 300 data bases) we have specialized in factual data bases, primarily in the field of economics[7]. Courses in information retrieval have become a good example for the usefulness of microcomputers in training and usage. Before students are allowed to retrieve data in a (cost-intensive) real world situation they are required to learn retrieval languages and strategies by using simulation programs written for PCs. This is done for both reference and factual retrieval. The PCs come into play again when students learn to load data down from external hosts into local personal computers and to process the data further according to predefined purposes (integration in a local data bank, editing abstract texts by a word processor program, applying linguistic algorithms, constructing an individual information service).

The objectives of the two courses B4 and B6, which form part of the core of the information management track[8], are very broad. We expect our students to learn to use integrated software packages by themselves after they have been systematically introduced into the principles and the practice of a major product (at the moment we prefer SYMPHONY but this can change with the advent of new products on the market). These two courses represent a good combination of theoretical and practical/experimental work (which is, by the way, also true for the majority of the other courses): two hours of theoretical lecturing or class room work and two hours of practical tutor-guided work in our PC lab; in addition to this we expect students to spend much more time with the PCs on their own, otherwise it would be impossible to reach the objectives of the final written examinations. An example for a topic students should

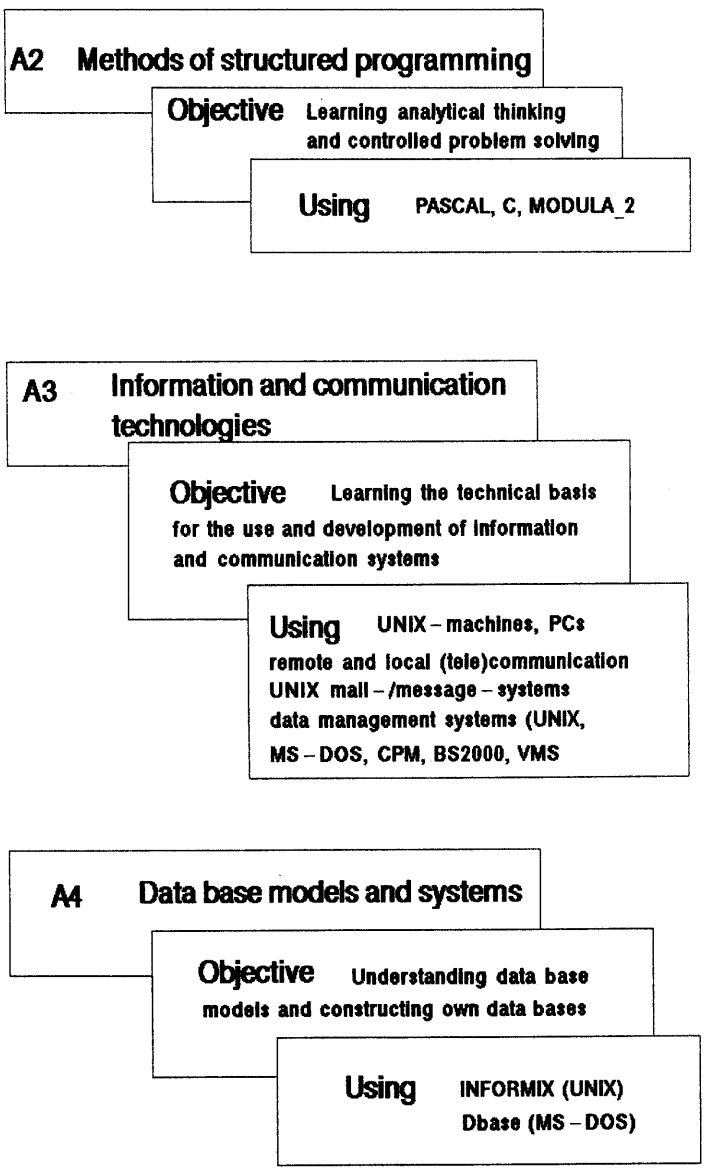

Fig. 5.1 Microcomputer – based courses

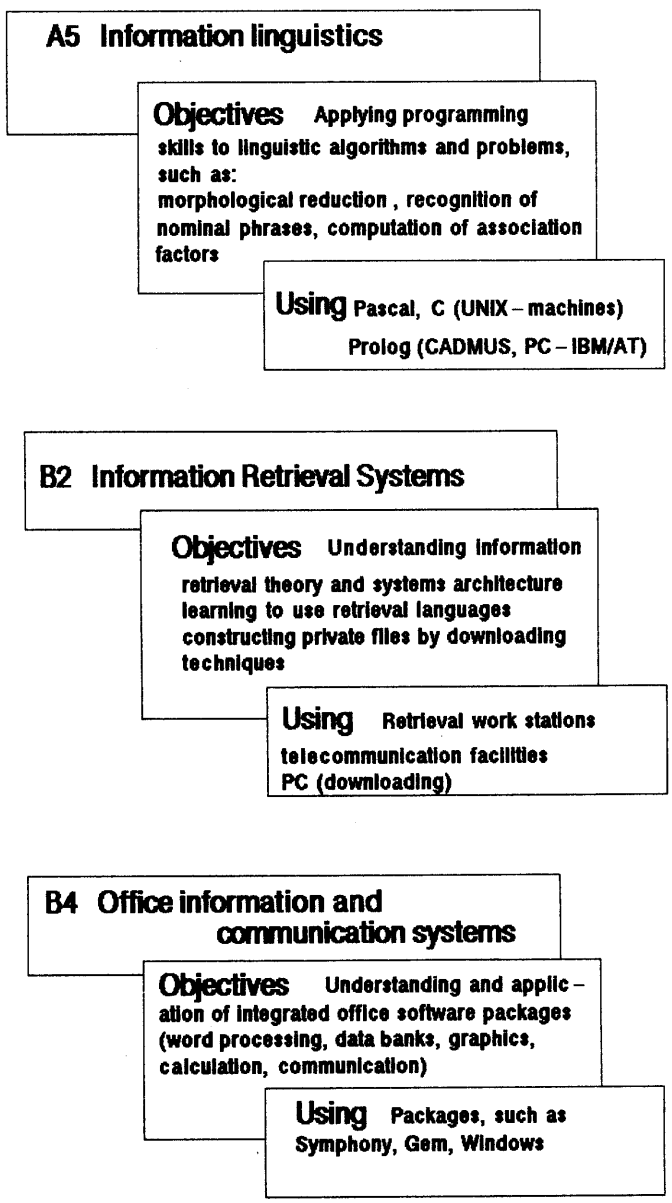

Fig. 5.2 Microcomputer – oriented courses

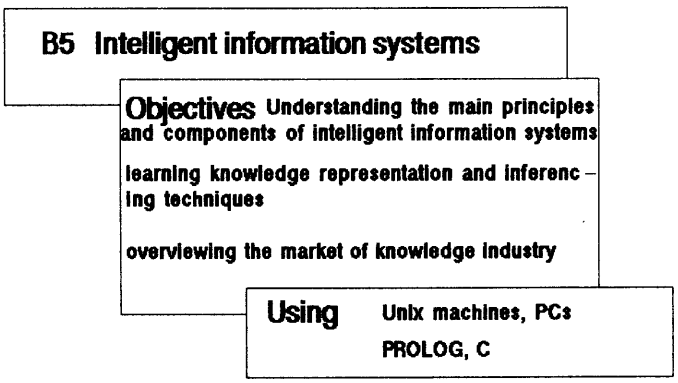

Fig. 5.3 Microcomputer – oriented courses

be able to write a paper about at the end of the course is a comparison of existing window programs such as GEM, WINDOWS, KNOWLEDGEMAN etc.

In their third and fourth semester students concentrate more on project courses. These projects courses are more time consuming than the introductory course at the beginning of the program of study and demand independent, in general group-oriented work. We encourage students to choose courses in which they can apply and deepen their knowledge and experience in information technologies. But there are also more theoretical and empirical project courses, such as the analysis of aspects of the international information market, comparison of office modelling languages or marketing strategies for information products. Examples for project courses which make use of microcomputer technology are:

development of an expert system in a limited knowledge area by using MICRO-PROLOG (APES-shell system)

development of a retrieval interface to relational data base system

systematic comparison of different integrated office automation packages

reconstruction of well known linguistic or artificial intelligence programs

comparison of different downloading programs

installing telecommunication facilities

Students normally choose the topic of their thesis for the degree from the general project course field in order to be better prepared to write a thesis in a very limited time (about two months). This furthermore encourages the students to become familiar with microcomputers.

5. Organizational problems of micro-computer laboratories

The shift from main frame orientation to microcomputers in education has undoubtedly improved the training situation, mainly due to easier access and to the usage of more flexible application programs, but on the other hand, this advantage has its price, mainly with respect to organizational responsibility, to maintenance of hardware and software, and to financial resources. I cannot discuss these problems here in detail but shall make a few remarks on the critical points.

The rapid change in technology means permanent reinvestment for both hardware and software. If universities decide to invest in PC-laboratories to a greater extent (according to the ratio: 10 students/1 PC) they must be prepared to accept the fact that hardware will become old-fashioned within a few years. It is hard to believe that universities will have the budget for permanent replacement.

Some people have already thought of an alternative solution, namely that universities make available only a very few, but highly comfortable or well equipped microcomputers, mainly for demonstration purposes, and that the students should be encouraged to buy their own computers'.

Normally universities are only prepared, if at all, to spend money for hardware and they don't take into account that the costs for software and tutorial support are equally as high. The development of software is even faster than that of hardware, and with the completely uncertain and unsatisfactory situation in software copyrigthing, universities don't know whether they are violating existing laws when they use software for more than one microcomputer. On the other hand, it is financially impossible to pay the full price or even a reduced price for cost-intensive integrated packages if a laboratory has, say, 12 micros which are used in course like the above mentioned "Office information and communication technologies".

Microcomputer education demands a great deal of practical work which must be supported by experienced tutors. It is hard enough to compete with offers from local industries which have a great demand for support in implementation and maintenance of commercial software - the poor budgetary situation of universities makes it quite impossible to provide students with sufficient tutorial assistance.

Microcomputer laboratories don't run by themselves. There is a lot of technical support and organization necessary not only in the first implementation phase but also, and even more time-consuming, for daily maintenance. Microcomputers when heavily used by computer beginners have to be configurated daily in order to keep them under control and functioning.

There are many other problems involved in the organization and maintenance of microcomputer laboratories, availability of appropriate rooms, sufficient budgets for all the extra costs which go with computers (floppies, printing paper, appropriate and ergonomic furniture, telecommunication and retrieval costs, etc.). Everyone who works in such an environment feels the pressure to cope with the rapid change in technology. But there is no way to avoid

this if the programs are to prepare students for their future professional work. Information science being responsible for different kinds of information work has to cover a wide variety of hardware and software which ranges from word processors, calculation, graphics, programming, data base application, information retrieval, office automation, and knowledge-based information processing. The variety is both a challenge and an opportunity. Information work is no longer the isolated work of specialists like documentalists but instead is an integrated part of almost all professional activities.

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1 Among or current projects are:
Topic/Topographic - a knowledge based text analysis system for the purpose of text condensation and with a graphically supported retrieval and (knowledge and text structure) presentation interface, cf Kuhlen 1984; Hahn/Reimer 1986; Thiel/Hammwhner 1986.
WisVer - Knowledge based information processing for the support of administration in the domain of "existence funding", cf. Kuhlen 1986a.
CurMod - Curricular models for information professions in organizational environments, cf. Kuhlen 1985.

2 For an overview of information science in West-Germany cf Kuhlen 1986b.

3 For this reason "information transfer" is sometimes referred to as "information resources management". We prefer to reserve the latter term for the internal organizational management of information.

4 For a more detailed description of the duties of an information transfer specialist cf Vogel 1985, 1986; Kuhlen 1985.

5 This program can be enriched by extra-curricular courses offered by other departments (psychology, linguistics, social sciences, economics etc.). Credit is required for only ten courses (7 courses from the 3 sections described in Tab.4, 1 project course and 2 courses of the students' own choice.

6 Therefore we prefer a contingency-oriented approach towards information science, cf. Kuhlen 1984.

7 cf. Staud 1986

8 At the moment the information transfer track seems to be much more under curricular control, maybe because this is more the professional background of our faculty; but the information management track is becoming more and more important and forms the core of the above mentioned project "Curricular model development". During the process of project planning and implementation the selection of courses in information management will be broadened, for example: office modelling techniques, system analysis, project management, simulation models/decision theory, economics of information, marketing strategies for information products, organizational theories, qualification profiles of technology-dependent information jobs.

9 cf Finke 1986.

References

Finke, W. 1986. Einsatz von PC-Arbeitsplaetzen in der Studentenausbildung. Universitaet Konstanz, Informationswissenschaft. Report MV/IW-1-86.-

Hahn, U., U.Reimer 1986. TOPIC essentials. Universitaet Konstanz, Informationswissenschaft, April 1986, Report TOPIC-19/86.-

Kuhlen, R. 1984. A knowledge-based text analysis system for the graphically supported production of cascaded text condensates. Universitaet Konstanz, Informationswissenschaft, Mai 1984, Report TOPIC-10/84.-

Kuhlen, R. 1985. Fortschreibung der Ausbildungskonzeption der Informationswissenschaft an der Universitaet Konstanz. Nachrichten fuer Dokumentation 36, 3, pp.160-165.-

Kuhlen, R. 1986a. Informationelle Absicherung von Verwaltungshandeln durch wissensbasierte Informationsverarbeitung bei der Administration von Existenzgruendung. Universitaet Konstanz, SFB 221 B3-1/86, April 1986.-

Kuhlen, R. 1986b. Das Fach Informationswissenschaft in der Bundesrepublik Deutschland unter besonderer Beruecksichtigung des Diplom- Aufbaustudiums an der Universitaet Konstanz (to appear in: P.Kaegbein, Koelner Kolloquium zur Bibliothekswissenschaft 1985. Arbeiten und Bibliographien zum Buch- und Bibliothekswesen, Verlag Peter Lang Frankfurt).-

Thiel, U., R.Hammwoehner. Graphical interaction with a full-text oriented information system. The retrieval component of the end user interface TOPOGRAPHIC (in this volumen)

Staud, J.L. 1986 (in this volume)

Vogel, E. 1985. The Konstanz conception for a postgraduate programme in information science: Information counselling and information management. Education for Information 3, pp.133-148.-

Vogel, E. 1986. Informationsmanagement und informationswissenschaftliche Ausbildung. Teil 1: Informationsmanagement in der oeffentlichen Verwaltung - Konzepte, Berufsbilder, Qualifizierung. Nachrichten fuer Dokumentation 37, 2, pp.79-92.-