RESTRUCTURING LIBRARY AND INFORMATION SCIENCE EDUCATION TOWARD KNOWLEDGE INFORMATICS EDUCATION: A CASE OF THE UNDERGRADUATE PROGRAM AT THE UNIVERSITY OF TSUKUBA

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Breakthroughs in high technology and improvements to the social information infrastructure have caused human beings, from business people to researchers to children, even the anchoritic, to search for and use information on a daily basis. The phrase "information search" had previously only been used by professionals, yet now it is being used by anyone. On the one hand, this is a positive result for library and information science. On the other hand, it means we are faced with the challenge to restructure library and information science as a professional and academic field. Given this situation, what role should a program in library and information science play at the university? Higher education in Japan has had to undergo an educational reform due to the increasing number of students and the increasing quantity of knowledge one must learn. This article discusses a new concept for library and information education based on our restructured framework. It also discusses the training of library professionals and the training of "communicative person" as a new human resource due to the development of digital communication, information technology, and the social information infrastructure.

1 Library and information science in a changing society

One of the chief purposes of an educational program in library and information science has been to focus on the development of professionals. With the shift in our society from an industrial to a knowledge-based society, the social importance of the library is being reinforced and the field of library and information science has also changed qualitatively and quantitatively. Additionally, the professional education programs in Japan have been required to change drastically due to technical and social developments as well as the present structural reform of higher education.

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Given this situation, what role should a program in library and information science play at the university? Higher education in Japan has had to undergo an educational reform due to the increasing number of students and the increasing quantity of knowledge one must learn. Some professional programs have already shifted away from undergraduate to graduate programs. This article will discuss a new concept for library and information education based on our restructured framework.

2 The history of library and information education at the University of Tsukuba

Library and information education at the University of Tsukuba consists of the College of Knowledge and Library Sciences in the School of Informatics as an undergraduate program, and the Graduate School of Library, Information and Media Studies as a graduate program. Our program was a pioneering one in Japan and has played a central role in this field. To begin with, we would like to provide an overview of the history of our educational program.

Modern librarian education in Japan began with the establishment of a library training institution in 1921. With this institution, our program found its origin. After several institutional changes, the Junior College of Library Science was established in 1964. From then until the 1970s, this college had played a central role in the education of librarians in Japan and many graduates have contributed to the development of libraries.

At 1971, the Junior College introduced Information Science, which had been called "documentation" at that time, into the curriculum. In 1979, the Junior College underwent restructuring and became the University of Library and Information Science, a university with a 4-year program and a Master's program. This reorganization provided the University with a higher professional education program. The University also introduced the computer science program into the curriculum, which went beyond the library and information science of that time, and aimed to integrate library and information science with information technology field (IT)[1]. This University played a pioneering role in the introduction of information technology into libraries and librarian training.

As a whole, the curriculum of the University of Library and Information Science, which was revised several times, had the following features:

1) The integration of library science and information technology
2) Emphasis on computer and information technology in the curriculum
3) Provision of a variety of courses with an emphasis on students' choice
4) Development of librarians and other human resources with library and information skills

This education system could, on the one hand, be evaluated as a pioneer in the field of library and information science not only in Japan but also in the world. On the other hand, this system caused an identity crisis within library and information science. The result being that the new library and information science consists of the individual fields of library science, information science, and information technology field, so how could a new library and information science be built as one discipline?

In the late 1990s, the direction that library and information science was taking in Japan came to be the most sought-after model due to the development of the Internet, contents technology, and related infrastructure. This interest led to the creation and present evolution of the field as knowledge science, information media studies, and contents technology.

In 2002, the University of Library and Information Science merged with the University of Tsukuba, and the undergraduate program of the former was transformed into the School of Library and Information Science. Again, in 2006, this School was restructured into the College of Knowledge and Library Sciences in the School of Informatics, which was being established at the same time. The

School of Informatics consists of three colleges; our College, the College of Media Arts, Science and Technology, a new addition with a focus on information media and contents technology, and the College of Information Science which focuses on computer science from an engineering point of view.

3 Educational Domains

The curriculum of the College of Knowledge and Library Sciences aims to deepen the traditional framework of library and information science and to tackle the essence of the present issue of digital communication. To "tackle the essence" means not only to study and understand how libraries are to deal with the development of digital communication, but also how to integrate library and digital communication into our curriculum. Therefore, some basic keywords of our new curriculum are "Knowledge sharing", "Knowledge resources" and "Integration."

Knowledge is the basis for an intellectual ability to learn and act in our life and is also commonly shared within society. This is a broad definition of knowledge and the idea includes not only scientific knowledge, but also various technologies and skills, common sense, and knowledge related to norms and customs.

Library collections and digital collections on the network can be considered "resources", knowledge resources, for the purpose of sharing knowledge. A library is a social institution for a society to retain its knowledge resources. Library and information science has traditionally focused on the area of the library and its documents. Its focus has generally been on the phenomenon of knowledge resource sharing. Knowledge resource sharing includes the issue of digital documents, since there is no reason that knowledge resources should be limited to books.

We call this expanded domain "Knowledge Informatics." (We think that the name of our College is not inclusive of this above idea, however naming an educational program in one organization is often affected not only by showing domain but also by political reason.) Comprehensiveness is a keyword that expresses a feature of this domain. Library and information science has developed as a comprehensive academic area. It is object-oriented and covers many approaches of the humanities, social sciences, and engineering disciplines. Knowledge Informatics inherits this object-oriented feature from library and information science through its concern for supporting social development by building and applying knowledge resources.

These various academic facets can be described by three keywords: "Human". "Society" and "Technology." (One should be careful not to use the existing discipline's names, such as the humanities, social sciences and engineering. This means that Knowledge Informatics should not be considered a farrago of these; it should instead be considered a creation of a new science focused on knowledge).

It could be said that an identity issue the University of Library and Information Science had hold was overcome through developing the above perspectives. The University of Library and Information Science opened a research area to develop digital contents near the end of the University. This research area was then developed into one of the core of the College of Media Arts, Science and Technology as another undergraduate program.

4 Drawing a picture of human resources in Knowledge Informatics

Traditionally professionals in the field of library and information science have been considered those who provided information, such as librarians and information specialists at information organizations. On the one hand, the professional information provider still plays an important role in our education program and we will continue to educate such a professional to cooperate with the Graduate School of Library, Information, and Media Studies.

On the other hand, as we mentioned above, the permeation of knowledge and information into our lives has been caused by the development of information technologies and the social information infrastructure. As a result, it seemed necessary to create a new picture against dichotomy between the education of information professionals as providers and the education of users who satisfy their own information needs with support from such professionals. Now many users can search, discover, and use information by themselves, and information literacy education intends to promote the ability to do these activities autonomously. Library and information science education could not have drawn an alternative picture for human resources other than the above dichotomy.

Therefore, the College of Knowledge and Library Sciences needs a new proposition for the drawing of a new picture of human resources in library and information science education. This new picture is clearly described in the phrase "communicative person." Simon (1976) introduced the concept of "bounded rationality" and divided "economic man" from "administrative man."[2] Compared

with Simon's idea, a "communicative person" is a person who acts based on the following view of human and society: human activity is borne out of knowledge and an essential element of human society is knowledge sharing. Human activity and the capacity for decision-making are part of a learning process with a dependence on knowledge, including the dynamics of its destruction and creation.

At this level, a "communicative person" may be an abstract concept. So, we have to give it the shape of human resources to accommodate the present context in Japan. That is to say, a "communicative person" is a person who puts emphasis on knowledge and information, who thinks, learns, and acts within the dynamics of knowledge in the diversified and changing society or in the establishing ubiquitous society. A "communicative person" is defined as a person who acts and learns in society by oneself beyond the dichotomy between information professionals as providers versus users who require their support.

Based on the above perspective, the College of Knowledge and Library Sciences educates two kinds of human resources. One kind is those information professionals who learn professional knowledge and the specific skills of knowledge informatics while at the same time being "communicative person" with a foundation of thinking as "communicative person."

The other kind is those people who understand the state of a knowledge-sharing society and is, himself/herself, engaged in various social activities and contribute to a society by learning a basis of thinking as "communicative person." The more highly the information infrastructure develops, the more usual acquiring knowledge and information becomes. Thus, it is important to establish the presence of human resources who can develop the dynamics of knowledge in social activities. To educate such persons should be the mission of knowledge informatics education.

5 Concept of Education

There is a standard education system in the matured academic area. However, the teaching of knowledge informatics should be structured developmentally, based on library and information science. First, some basic ideas concerning the undergraduate education of knowledge informatics should be discussed. Its main focus is professional knowledge and the technologies of knowledge sharing and knowledge resources, and the professional knowledge of the information sharing phenomenon.

From the many aspects of knowledge informatics mentioned above, we can rephrase what has been discussed as follows: the parties interested in knowledge and information are restricted in human beings. Then we need to understand knowledge sharing as it is involved in the thinking and behavior of those who use knowledge resources. Human beings can socially share knowledge by communication <Human>. Society builds knowledge resources to share and has developed a social system of knowledge resources <Society>. And technology plays an essential role in all of them <Technology>.

From a "communicative person's" perspective, the present society requires us to understand what knowledge and information is, to have flexibility to consider things multilaterally, to solve the various social problems with practical skills and available technologies.

Understanding of knowledge and information extends to various areas of traditional disciplines. It is easy to list many examples, such as philosophy and logic, sociology, law, organization theory, psychology and cognitive science, information science, systems science, and so on. However, it is hard to say that students study this widespread knowledge comprehensively and in correlation with each other. To build a basis of knowledge informatics, we should endeavor to take on this task.

Based on the above points, we can say that the curriculum of knowledge informatics should retain library and information science, and also cover various other academic areas. To acquire flexible perspectives and problem-solving ability, such education needs to consist of ideas and skills of each academic area and integrated professional knowledge and skills based on these various areas. Thus, the College of Knowledge and Library Sciences has three majors: A Major in Knowledge Studies, a Major in Knowledge Systems, and a Major in Information Management and Libraries.

The Major in Knowledge Studies focuses on the <Human> element and students learn about the essence of knowledge and information behavior, ideas and ways of knowledge acquisition, skills for information seeking, the nature and method of the intermediation technology of knowledge and information, information analysis and knowledge discovery, and social research methods.

The Major in Knowledge Systems focuses on the <Technology> element and students learn about the foundations of computers and networks, organization of information resources, design of database schema, web technologies, management of knowledge information systems.

The Major in Information Management and Libraries focuses on the <Society> element and students learn about social meaning and the management of knowledge and information institutions and

the providers of such, social and cultural systems of knowledge and information, and knowledge of social and cultural activities.

6 The curriculum of the College of Knowledge and Library Sciences

We would like to provide an overview of the curriculum of the College of Knowledge and Library Sciences. The undergraduate curriculum at the University of Tsukuba consists of General Subjects provided by the University, which are mainly targeted at freshmen, Basic Courses for Major provided by each College, which are targeted at freshmen and sophomores, and Major Courses provided by each College (See Figure 1).

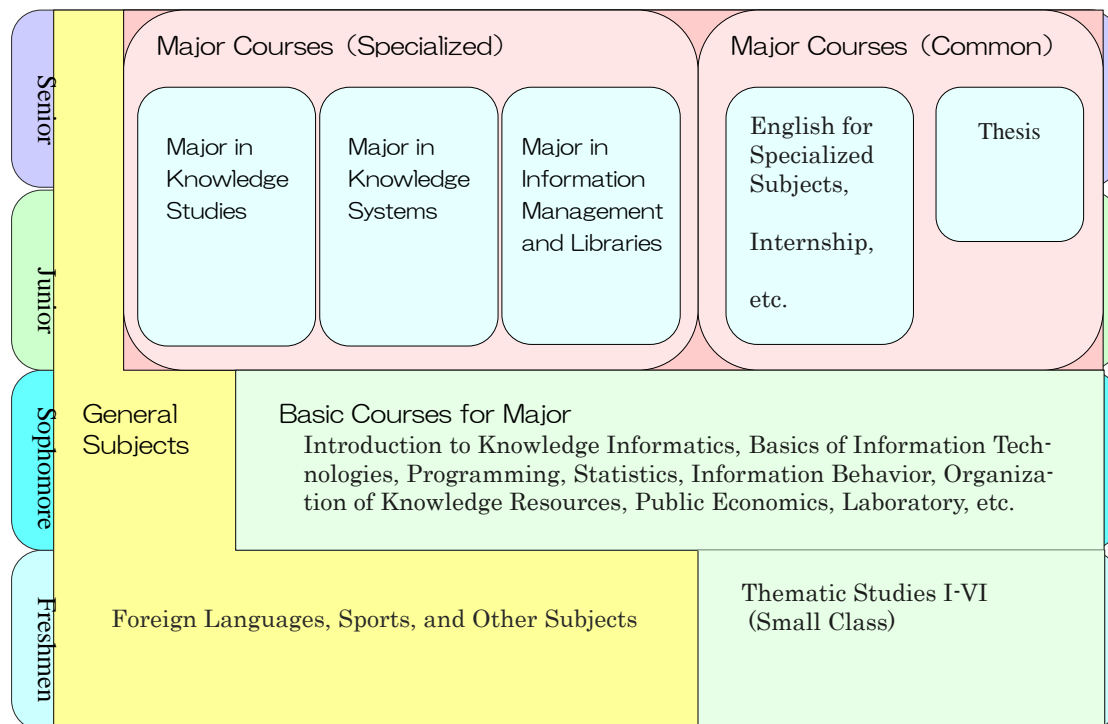| Senior		Major Courses (Specialized)			Major Courses (Common)	
Junior		Major in Knowledge Studies	Major in Knowledge Systems	Major in Information Management and Libraries	English for Specialized Subjects, Internship, etc.	Thesis
Sophomore	General Subjects	Basic Courses for Major — Introduction to Knowledge Informatics, Basics of Information Technologies, Programming, Statistics, Information Behavior, Organization of Knowledge Resources, Public Economics, Laboratory, etc.				
Freshmen		Foreign Languages, Sports, and Other Subjects			Thematic Studies I-VI (Small Class)	

Fig. 1 Curriculum of the College of Library and Knowledge Sciences

Our Basic Courses for Major consist of many general courses, such as sociology, economics, philosophy, mathematics and statistics, which are related to the idea of knowledge sharing. Students study "Programming" at the freshmen level, and "Laboratory" to apply information technologies at each stage of library services in their sophomore year. The aims of the "Laboratory" are for students not only to acquire information skills, but also to understand the necessity of learning information technologies through practice. As a whole, we can not provide so many courses and our aim is that students should study "Knowledge Informatics", rather than "Library Science and Information Science."

We would like to introduce the "Knowledge Information Resources Laboratory" as a typical course in order to express our curriculum concept sharply. This course aims to help students acquire skills from a number of perspectives of the <Human>, <Technology>, and <Society> elements. Students have to take "Knowledge Information Resources Laboratory I" to learn about organization technologies, "Knowledge Information Resources Laboratory II" to learn about service technologies, and "Knowledge Information Resources Laboratory III" to learn about retrieval technologies all in their sophomore year. The contents of this course consist of technologies needed in the networked society in Internet era from the view point of library and information science. The instructors of this course refer to the contents as "Knowledge Architecture 2.0" (See Figure 2).

"Knowledge Architecture 2.0" combines the traditional skills of library and information science with cutting-edge information technology skills. The contents of this "Knowledge Architecture 2.0" will be changed as information technology develops. This "Knowledge Information Resources Laboratory" puts an emphasis on students learning many views of rule, implementation, utilization and structuring. When the students learn an OPAC system, for example, the instructors enable them to under-

stand two dimensions of bibliography data: bibliography data from cataloging rules and bibliography data as a database.
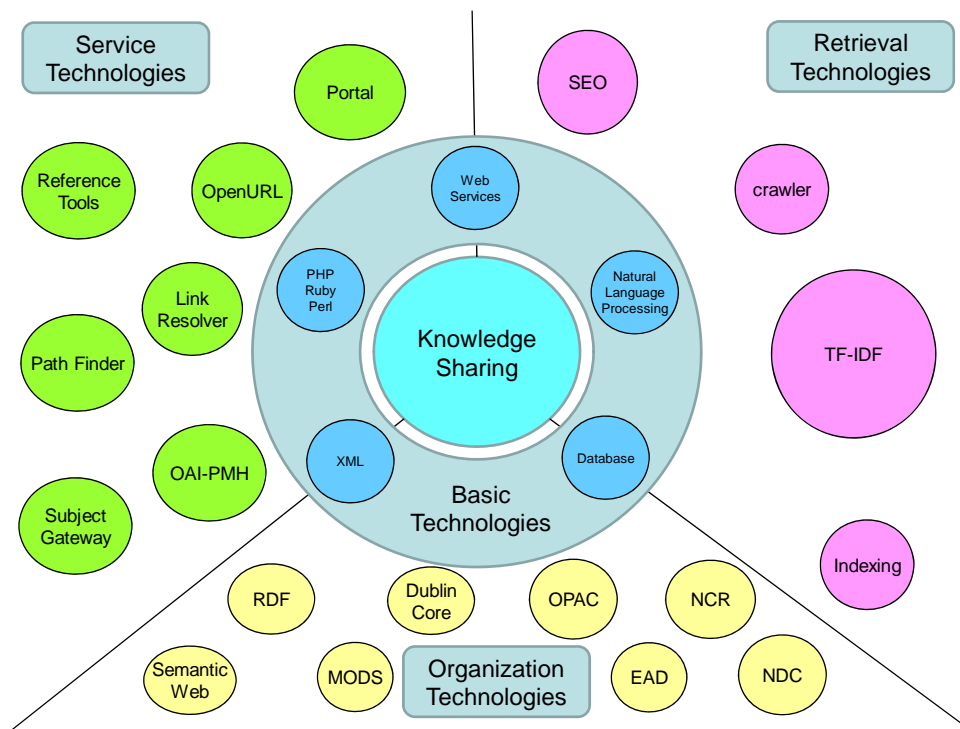

Fig. 2 Knowledge Architecture 2.0

In 2008, the first "Knowledge Information Resources Laboratory" was opened. In the "Knowledge Information Resources Laboratory I," from April to July, the students made bibliography records based on the Nippon Cataloging Rules (NCR) in the earlier half of the course and they built the OPAC system using that bibliography data in the latter half. According to the course evaluations done by the students, one student said, "I felt the earlier work was totally different from the later work." Yet another student said "I understood the meaning of this Laboratory when I was in the latter half." We can say that our new curriculum could achieve some positive results, while there are some improvements that need to be made.

7 Conclusion

This article discussed the deepening of education in library and information science at the undergraduate program level and the transition to knowledge informatics based on the curriculum reform of the University of Tsukuba. It also discussed the training of library professionals and the training of "communicative person" as a new human resource due to the development of digital communication, information technology, and the social information infrastructure. These affected the framework for the curriculum of the College of Knowledge and Library Sciences. Now we have sophomores this academic year and would like to implement our curriculum thoroughly. Although we have not had any students finish our program yet, we would like to point out the challenges for the future regarding our education program.

A practical area based on knowledge informatics should be considered broadly. For example, museums and archives, information dissemination by network, building and operating of information systems and so on. However, it does not seem that our curriculum can cover such broad areas of social and technical contents. It is not necessary to say, on the one hand, that knowledge informatics needs to advance through specialization based on the diversified practical area. On the other hand, it is necessary to say that knowledge informatics needs to create a common edifice of knowledge. This point may be a big and future issue.

For the College of Knowledge and Library Sciences, one of the hot issues is an articulation of the need for a graduate program. We can not adequately educate human resources who would be suffi-

ciently specialized at the undergraduate level alone. It is clear for us that we have to provide a more advanced professional education. Near future we would like to develop a coherent graduate program in library and information science hereafter.

Notes

1) There has been confusion of terminology in Japan between Information Science as a successor of Documentation and Information Science as an academic field of information technology or information processing. To avoid confusion, the former is referred as Information Science and the later as Information Technology field in this paper.
2) Simon, H.A. (1976). *Administrative Behavior: a study of decision-making processes in administrative organization* (3rd ed.). New York: Free Press.

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