Adaptive Search Information Technology in the University Library

AndriyAndrukhiv and DmytroTarasov

Social Communications and Information Activity Department,
Lviv Polytechnic National University, Ukraine, Lviv, 12 Bandera Str.

ABSTRACT

Information provision of the educational process in the university is aimed at implementing of new information technologies and software into all spheres of university academic activity in order to provide students with qualitative educational material. Forming of new information society, development of Internet network and growing number of electronic resources caused new conditions for research libraries that traditionally are guides in information environment. Modern library user demands new standards of services to satisfy information needs during one's studies. Simultaneously, university management sets the goal to increase education quality through organization of work on information support of educational process scientific methodic literature. Consequently, research on information support of educational process in higher educational institution would allow organization of qualitative collaboration between the library and subdivisions of higher educational institution, and consequently improve book supply for educational process and optimize funds necessary to buy new materials. The article describes the algorithm of literature recommendation to academic courses. The algorithm improves the information support of students during course study and enables academic teachers to form recommended literature list in automated way. The algorithm work is a basis for information system introduced in Lviv Politechnic National University, Ukraine.

Keywords

Library information system; OPAC; web-based library systems; e-learning materials, educational process.

1. INTRODUCTION

The problem of online access to scientific and education information is a vital issue nowadays. A few years ago, the center of access to scientific information was the library, but with the development of information technologies the Internet took library's place[1,6]. This change was caused by late development of information technologies in Ukrainian libraries. Ancient and traditional role of library as an institution of acquiring, organizing, preserving, retrieving and disseminating information to users has changed. In current information society, libraries are trying to stay influential institutions via providing access to Internet resources. However, due to global commercialization of scientific resources, the Internet may not

always provide all the necessary information. Taking into account the tendency of scientific community to turn to electronic documents and the expansion of the range of services, libraries have to organize their work in the way to satisfy user information requirements as soon and as well as possible.

To solve this problem, the automation of library processes is being conducted. This involves:

- computerization of workplaces;
- creation of a data center for storing and processing the large-scale data sets;
- selection/development of own and support of appropriate hardware and software;
- alteration of the principles of library management, taking into consideration new forms of service, etc.

Solution of one of library informatization problems leads to a range of other problems[3]. For example, computerization of a workplace involves:

- computer equipment maintenance (repair, software updates and technical support);
- equipping the workplace (desk, chair, peripheral devices, etc.);
- access to network resources (connection to the local area network and electric power supply network);
- selection and purchase of software;
- managing occupational health and safety and health requirements (organization of appropriate lighting, safe work with the computer, air-conditioning, heating, choice of room for installing computer, etc.)
- training staff to work with the computer;

All-inclusive library automation is a difficult task to implement in the field of information technologies. It requires enrollment of skilled librarians, systems analysts, linguists and programmers.

2. THE ACTUALITY OF THE RESEARCH

Reformation of educational system in Ukraine and implementation of new educational technologies provided by the Bologna process significantly increase the role of libraries in information support of academic, learning and research activity of the university. Library must consider an information flowthat is constantlybeing increased and find new ways and possibilities to collaborate with university departments as with subjects ofnewinformation andeducational environment in order to stay needed and essential institution. Everyone is interested in improving the information provision of students: library will have its service user, academic department will be given

accreditation and students will have qualitative sources of information for studies. Therefore, information support of education process is one of the key goals of university and its library.

3. WEB-TOOLS OF INFORMATION SEARCH IN THE UNIVERSITY LIBRARY

Informatization of the Scientific Library of Lviv Polytechnic National University started in 2007 and a large amount of work has been done by now. The Scientific Library proposes the following services: library website, institutional repository[2], electronic catalogue (OPAC) and several new special web-based services for our users such as form to find UDC, Ask-a-librarian, literature recommendation system for studying academic disciplines in our university (see Fig.1).
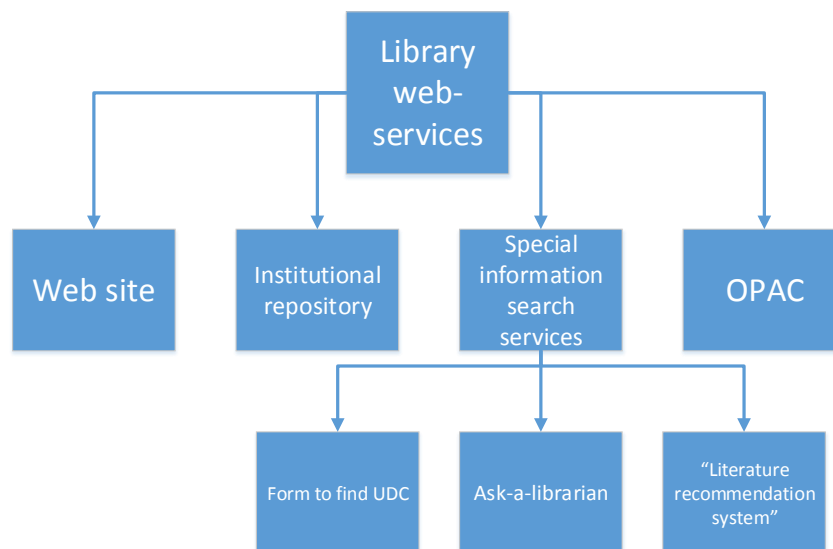

Fig. 1. The Scientific Library user-oriented web services.

Let us briefly and comprehensively dwell upon each information resource.

1. Library website (http://library.lp.edu.ua) plays a significant role in the life of the library, as it is the primary resource of library events representation on the Internet. The website has been built with the help of Drupal 7 CMS. We use Drupal 7 because there are a lot of different modules that give us opportunity to integrate library services with web-site. We analyze web-site each year quarter and get average statistics:statistics:

    ❖ About 5 000 visits per month;
    ❖ About 750 pages indexed in Google;
    ❖ Links to web site – 57 200;

2. Lviv Polytechnic National University Institutional Repository (http://ena.lp.edu.ua) was created on May 15, 2010. Currently the repository contains more than 25 000 items. It has been built with the help of Dspace software.

3. OPAC (Online Public Access Catalogues) is an important part of many digital library collections. It allows users to search for the bibliographic records within library collections. Nowadays, some OPACs also provide access to electronic resources and databases, in addition to the traditional bibliographic records. Our OPAC was created in 2008 by the IT Department of Scientific Library (http://library.lp.edu.ua/en/it_department). This solution gave us opportunity to connect google-analytics to the OPAC and create own thematic statistic system. So we know two main points of visiting statistics: number of users and kind of literature they are looking for. So, we have 396212 records in OPAC and about 500 visits per month. The next figure shows what kind of literature users are looking for.
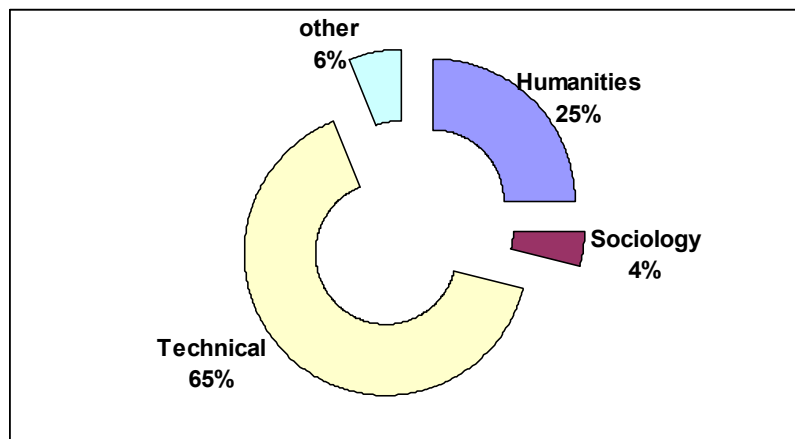

Fig. 2. Thematic searches in OPAC

In spite of that, we know that the most popular literature in OPAC is scientific literature – about 60 percent of search queries, literature for students – 37%, and 3% – other literature.

4. Special web-based services for users are:
- form to find UDC;
- Ask-a-librarian;
- literature recommendation system for studying academic courses in our university.

4. NEW SPECIAL INFORMATION SYSTEM "LITERATURE RECOMMENDATION SYSTEM"

The new service for library users is service that selects literature needed to study academic discipline from the library collection. In Ukraine, the official document that defines the qualitative and quantitative characteristics of the process of discipline study is course program. One of the sections of this document includes book list, which student must work out to learn the material well. To perform the task of qualitative and complete formation of literature and reference list for the course teacher must be aware of the available literature in the library and be able to find this literature and constantly keep up with new materials within one's research field. Information system that recommends above named literature to academic teacher would significantly ease one's work. Teacher would only make decisions whether to include or not include this or that position from course program to the recommended literature list. Moreover, when the list is formed on the base of library collection it improves up to date information support of educational process.

In Lviv Polytechnic National University there is information system for recommended literature selection developed and introduced. Algorithm of its functioning is shown on the Fig. 3.
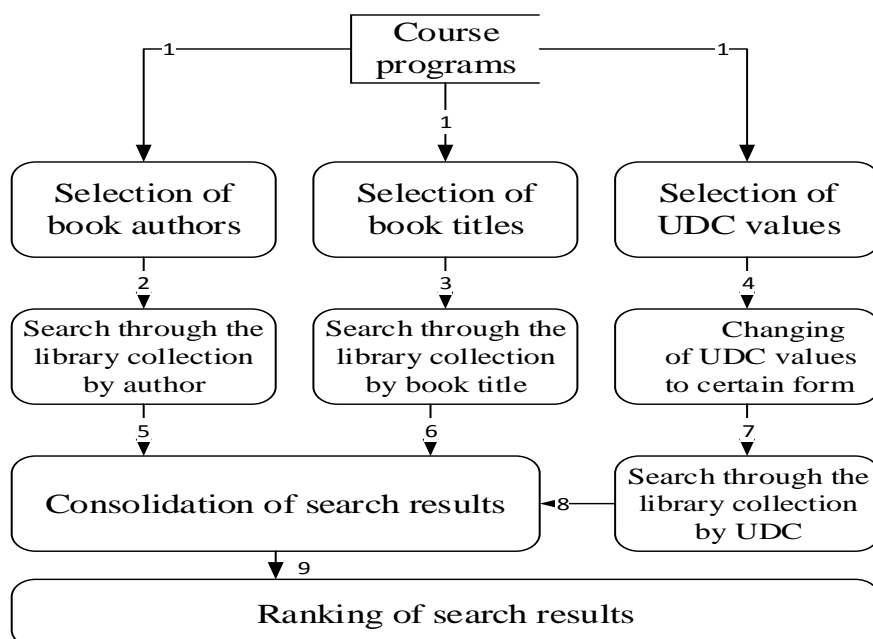

Fig. 3. The algorithm of formation of literature list for the course

where

1. Bibliographic records from recommended literature list for the course;

2. Tuple of book authors from recommended literature list;
3. Tuple of book titles from recommended literature list;
4. Tuple of UDC from recommended literature list;
5. Results of search by author through the library collection includes all book sof authors from recommended literature list;
6. Results of search by title through the library collection includes all book titles from recommended literature list;
7. Tuple of UDC adapted into form suitable for next iterations;
8. Results of book search through the library collection includes positions with certain UDC;
9. Combined book list from different iterations.

The next step after list formation is list ranking. Ranking of selected search results will be done based on multi-criteria estimation of the relevance of found documents taking into account the following criteria:

- author and title of a book;
- factor of research technical bookaging (year of publication);
- statistical data on book demands;
- number of book pages.

Algorithm work is shown on the Fig. 4.

We divide the mentioned criteria into two groups: main and specified. Main criteria are autonomous criteria that are used to find relevant results. Specified criteria are to increase the pertinence of relevant results received after using the main criteria. In our case main criteria include the title and author of a book and specified criteria include factor of research technical book aging, statistical data on book demands and number of book pages.

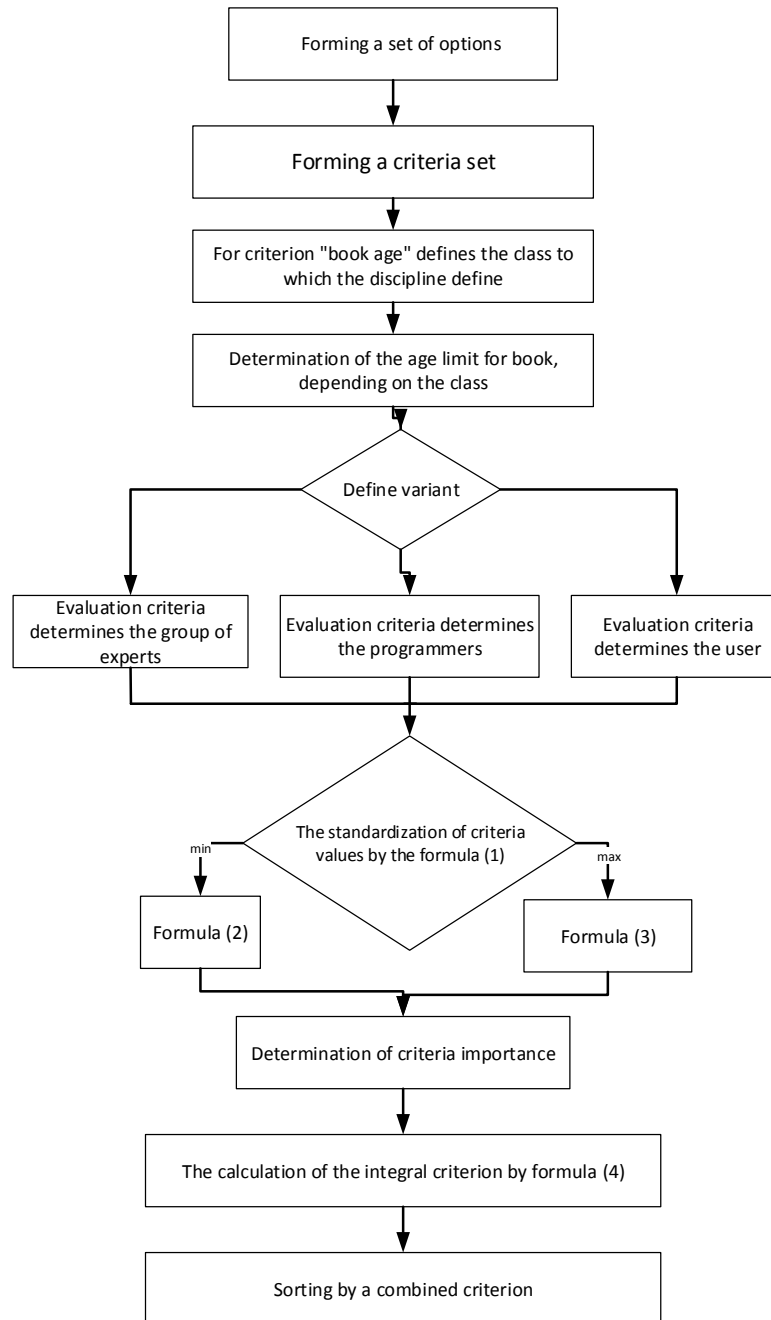### 4.1 Criterion of Book Author and Title

The below given presumptions are based on the thesis that if an expert (staff member) has chosen books of one author, other books by the same author may also be valuable for the same expert. Researchers commonly publish their works within a specific research field and quite rarely bounce to another one. For example, if an author works in building and architecture then this person will rather not write next papers on computer processors. In practice, it means that authors from recommended literature list have to be the same as these from library collection. The similar situation is also with book titles.

4.2 Factor of Research Technical Book Aging

Factor of research technical book aging is important because documents with flow of time last their value as information source; consequently, they are being used less and less. American researchers Burton R.E. and Kebler[5] R.W. proposed the term "half-life" to describe literature obsolescence.

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┌─────────────────────────────────┐
│     Forming a set of options     │
└─────────────────────────────────┘
                 │
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│       Forming a criteria set     │
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│ For criterion "book age" defines │
│ the class to which the discipline│
│              define              │
└─────────────────────────────────┘
                 │
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│ Determination of the age limit   │
│ for book, depending on the class │
└─────────────────────────────────┘
                 │
                 ▼
            ◇ Define variant ◇
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Evaluation criteria determines the group of experts

Evaluation criteria determines the programmers

Evaluation criteria determines the user

The standardization of criteria values by the formula (1)

min

max

Formula (2)

Formula (3)

Determination of criteria importance

The calculation of the integral criterion by formula (4)

Sorting by a combined criterion

Formula (1): $w_d(f_d(x)) = \dfrac{f_d(x) - f_d^{min}}{f_d^{max} - f_d^{min}}, d = 1, \dots, N$

Formula (2): $w_{dk}(f_d(x))$

Formula (3): $w_{dk}(f_d(x)) = -w_{dk}(f_d(x))$

Fig.4. Evaluation of literature search results. Ranking algorithm

This number means period of time during which a half of all published papers in some branch of science is out of use. For instance, they found that the half-life of journal articles in physics is only 4.6 years, in chemistry it is 8.1 years, in mathematics this number is 10.5 years and in physiology it is 7.2 years. It must be emphasized that, by the aging process we understand a process of information obsolescence, but not physical aging of the information carrier. According to the study 62% of users are turning to journals, whose age does not exceed 1.5 years; 31% use journals aged 1,5-5 years and 7% count on publications older than 10 years. Thus, we can claim that the document age is clearly connected with the intensity of its use and therefore can be used in ranking.

4.3 Statistical Data on Book Demands

In order to improve the effective reader service and library collection management we use the analysis of statistical data on loaned and requested books[4].

Data on library book use is an important criterion in ranking. Analysis of information needs and requests can show current reader trends and dynamics of reader interests. If the book is popular among users then it is valuable for them and satisfies their information needs. The level of demand is measured in number of books loaned by readers. These data are kept in Library Information System (ALIS). In this case we do not take into account time aspect (number of books loaned during certain period of time), because not all books were registered in catalogue at once. Consequently, book could not be found, because it was not in catalogue in the moment when user needed it. Statistical data have to be analyzed before using in order to remove splashes of activity caused by the period of exams. In classical tasks of decision-making theory, normalizing coefficient that lies in the area of feasible solutions is introduced.

Statistical data on literature demands are subjective. They show some aspects of book's value from the point of view of reader, but do not mirror real level of reader's information satisfaction. Students are major users of university library and they use books recommended by academic teacher. That is why books recommended by teacher would be highly demanded while others would be undemanded.

4.4 Number of Book Pages

This criterion appeared as a consequence of library collection peculiarity on the step of transferring information from library collection to electronic catalogue. Some libraries' definition of "book" includes guidelines for laboratory or term papers, promotional materials, etc. This is to simplify the library work. The distinctive peculiarity of academic textbooks is huge number of pages. There were selected 2,000 guidelines for laboratory and term papers, lectures and brochures for our study from the collection of

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Scientific Library of Lviv Polytechnic National University. It has been found that 1910 (or 96 percent) of these documents does not exceed two publishing sheets. Therefore, it is advisable to analyze books containing more than 50 pages.

Problem of multi-criteria optimization plays key role in decision-making theory. To solve this problem, partial criteria must be merged in one integer criterion and then its minimum or maximum found. There are few types of generalized criteria depending on the way of partial criteria combination: maximin, multiplicative, additive (or linear convolution). To solve the problem of ranking of bibliographic description list it is needed to build the objective function that combines partial criteria. With this function we can determine the relevance of each bibliographic description. For ranking of found literature we use the algorithm of multiplicative criterion using above mentioned criteria.

5. RESULTS

The literature recommendation system was developed via PHP+Apache+MySQL by the Library's IT Department of Lviv Polytechnic National University Library. Data in this sytem are synchronized daily according to ALIS through ODBC protocol. The peculiarity of this system is that user is given an opportunity to fill feedback form (see Fig.6), find details of system functioning and ways to implement defined books in educational process.

The algorithm which is described in this article is the basis of an information system which is available on http://library.lp.edu.ua/ttp/. It is a separate webpage, where the user is offered to look for the necessary subject and review recommended references.

If user thinks that the available references have to be changed, the form is offered, where user can enter one's requisites and list of reference changes. On the same webpage user can operate the function of literature recommendation for a certain course.

The generated list is analyzed by the teacher. The marked literature that can be attached to the subject goes to the librarian, who analyzes it and makes changes (Fig.5).

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Fig. 5. An example of literature recommendations for the course of "Foreign languages".

Fig. 6. An example of literature recommendations feedback form

For processing and permanent storage of the results of a web module work person may use:

– regular automatic data export in the ALIS (for users' profiles updates in the ALIS, literature ranking for rank forming in the electronic catalogue of the ALIS);

– sending automatic information to library staff via e-mail (for the function of feedback).

6. CONCLUSIONS

The article describes a new service that the library offers for its users. It will allow the university to improve the quality of information support of educational and management processes, and provides automated solution of formation of recommended literature lists and making updates to them. The teacher receives a number of integration benefits: formation of recommended literature lists, designed according to the current bibliographic standards, intelligent algorithms of automatic selection of literature for the courses, and notification about new books related to the course.

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