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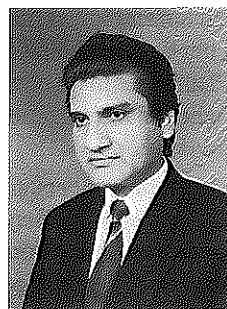Loughborough University of Technology, England

Recent Trends in Subject Access to OPACs: An Evaluation

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Research conducted in the early 80's has shown that subject access is still one of the most dominant approaches in OPACs. However, while some of the subject searches result in no recall, others often retrieve so much that users are discouraged to proceed further. These and other problems were investigated and solutions were found in improving search methods (such as word stemming, extending search to full bibliographical record and providing end user thesaurus) and indexing techniques (such as by enhancing subject headings with the table of contents and back-of-the-book indexes or by traditional classification systems). More recent research indicates that the real answer to the question of 'precision without sacrificing recall' lies in developing 'user friendly novel interfaces' and also in designing 'knowledge based systems', wherein users would not be expected to learn query formulation or even to be familiar with the indexing language of the system. Several interesting studies and research projects on the subject have produced a whole gamut of information, but one can still visualize the evolving trends of research vis-à-vis their future prospects as possible solutions.   (Authors)

0. Introduction

It has been man's continual quest to be able to identify and have access to the recorded forms of knowledge, for which a library catalogue serves well. Of the various approaches that may be made to the catalogue, subject access has long been engaging the attention of library professionals, perhaps as long as libraries themselves. It may be recalled that the catalogue developed by Callimachus (305 BC - 240 BC) for the library of Alexandria basically served subject access to its collection (1). One simple reason for subject access being problematic is that librarians want to serve an approach of which not even the user himself is sure. Hence, difficulties arise in analysing and indexing the subject on the one hand and in searching on the other. However, the emergence of the 'Online Public Access Catalogue' (OPAC) in the 1980's, promised to minimise these problems, while offering better subject access capabilities and the enormous potential of embracing other bibliographical databases and even full text search facilities.

Great interest and also a growing interest in OPACs in general and subject access in particular, has led librarians and information scientists to undertake interesting research studies and projects that have, in effect, produced much literature on the subject. Various recent studies have provided both an overview of general developments (2) and some detailed examination of the problems involved (3). This paper, therefore, aims to review and evaluate evolving trends of research in subject access to OPACs with a view to assessing the present state of the art and its future prospects.

1. Development of OPACs

Since their emergence, OPACs have undergone large scale improvements but the basic contention remains their accessibility by library clientele without any formal training. In the light of their functional capabilities, OPACs, according to Hildreth (4), have developed through the following three generations:

1.1 First generation

'Phrase searching OPACs', as they are generally called, were, in a way the machine readable forms of conventional catalogues providing such access points as class mark, author, title, subject as phrase and simple left to right phrase matching. Such systems had certain obvious drawbacks, for the probability of exact matching between search phrases with indexing terms was rather small: Much of the computer capabilities were wasted as the system worked like a card catalogue. It was not user-friendly as user/system interaction was quite limited.

1.2 Second generation

Most of the existing OPACs are still at this stage. Influenced by the commercial bibliographic databases, second generation OPACs have adopted many of their features like 'online help messages', 'alphabetical index displays' for selecting search terms and using 'Boolean logic' for their combination and effective retrieval.

Despite the improvements, the second generation OPACs have made over the first generation, Hildreth (5) regards them as 'deficient tools' for effective subject searching, for the following reasons:

1) they offer little or no help in translation of entry query terms into the vocabulary used in the catalogue;

2) they provide no help to the user in making alternate search statements and techniques, when the initial approach fails;

3) they do not, in all cases, lead to a successful free text search (e.g. of title words); to the corresponding subject headings or class numbers assigned to a broader range of

related material;

4) the retrieved records are generally devoid of such information as tables of contents, abstracts and book reviews, that might help the user to judge the usefulness of the documents;

5) the retrieved bibliographical records are not ranked in decreasing order of relevance to the user;

6) exploratory browsing to retrieve materials related to those already found is not facilitated.

1.3 Third generation

The above listed deficiencies were investigated and some of the remedies that emerged, were incorporated into third generation OPACs to enhance their subject searching capability. These systems are enriched by the inclusion of additional controlled and uncontrolled access points. Queries are accepted as a 'natural language' statement eliminating the need for the user to know query formulation and search techniques. Some of the systems use partial match techniques instead of Boolean operators. The retrieved sets are sometimes ranked according to the query relevance. These catalogues ensure vastly improved search system interaction at every level of the search process. Though most of the work is at the experimental stage, some elements of third generation OPACs may be found in CITE at the National Library of Medicine, USA; OKAPI at City University, London, and SPRI-LAB Online Catalogue at the Scott Polar Research Institute, Cambridge.

2. Subject Access in OPACs: Problems

Subject searching in online catalogues requires the translation of users' information needs into the terms, that have been used in the system's vocabulary. They are then put in some specific statements or in the command language of the online catalogue, matched system's vocabulary retrieve the records to be delivered to the users. During this process, not all subject searches are one hundred per cent successful. They result sometimes in 'no retrievals' or 'too many' records, so that the users will be discouraged to proceed further. In either case, the user suffers. Larson (6) calls these two problems 'search failure' and 'information overload' respectively (see Fig.1).
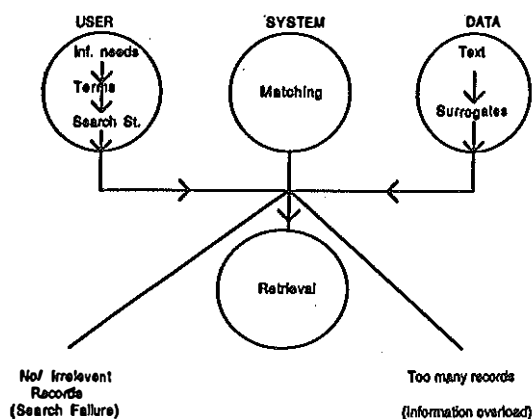

Fig.1: Diagrammatic representation of subject access in OPACs

2.1 Search Failure

A search failure, generally deemed to be a search that retrieves nothing, is not always that obvious. If the retrieved items do not best serve the users needs, the search will be no better than a failure. However, a successful search depends upon the perfect coordination between the user and the system. Any major deficiency on the part of either of the two, results in search failure. Some of these deficiencies are discussed below.

2.1.1 Query Formulation

Users are always not able to formulate their search according to the terminology of the system, generally the Library of Congress Subject Headings (LCSH). Interestingly, Steinberg and Metz (7) found that only 72.8% of the OPAC users were not sure that LCSH were the same used for subject access both in the card catalogue and in the OPAC. In fact, a number of researchers laid much of the blame for subject search failure onto the LCSH, which they described as obscure and cumbersome for users. Karen Markey (8) in an analysis of 859 subject queries, found that only 18% were exact matches of LCSH. On the other hand, 36% of the queries were whatever popped into a searcher's mind, and of this, 36-65% resulted in no retrievals. Difficulties in formulating a search strategy involve problems of syntax, semantics, choice of access points and how to narrow or broaden a search, etc. (9). It, therefore, follows that users' lack of knowledge of LCSH, misspelling and mistyping account for only a few causes of search failure. Markey (10) suggests either educating online catalogue users about search strategy and heuristics or providing in-built instructions in the system. In the same vein, Smith (11) writes:

"Patrons might use LCSH but they certainly don't understand it. It has always been difficult to explain 'x' and 'xx' or 'sa', but now we have to try to understand as well as interpret for users use, UF, BT, RT, SA, NT. If patrons do know to use the LCSH volumes to structure a search and if a printed copy is available, it is entirely possible that there would be no entries in the online catalogue for the term selected and a well constructed search will result in no retrieval".

This brings in the problem of assessment of intactness and accuracy of the online catalogue itself, a model which was presented by Cook and Payne (12).

2.1.2 Application of 'Boolean Operators'

Boolean operators (AND, OR, NOT), a backbone of almost all information retrieval systems including OPACs, though usually considered good for retrieval, have been criticized by Bookstein (13), Belkin and Croft (14), etc. for exploiting only a portion of the information potentially available in the systems. Some of the main objections are discussed below:

1) The Boolean AND operator often results in search failure. For example, a search for 'A and B and C' will retrieve records that have all the three terms and will reject those with one or two of these terms.

2) Boolean logic is rigid in nature, for a user making a search 'A and B' cannot indicate that the term A is more important for his search than B or vice versa.

3) Documents are either retrieved or rejected, with no middle ground.

4) Ranking of retrieved documents according to the degree of relevance to the enquiry is not possible.

The above objections are confirmed by the Council on Library Resources studies of 1982 and 1983 (15). Reports state that subject searches using keywords with a non-Boolean strategy or with search arguments providing a partial match with controlled vocabulary terms often produce a large number of citations.

As an alternative to a Boolean search operator, some partial matching techniques, as reviewed by Belkin and Croft (14), were evolved. Techniques in this category are used to compare queries with documents represented as sets of features or index terms. The document representatives are derived from the text of the documents. Features can represent single words, stems, phrases or concepts and can have weights associated with them. The query terms can be derived from a query expressed in natural language or with the help of the indexing vocabulary. The retrieval techniques are based on formal models of document retrieval and indexing, viz. vector space, probabilistic and fuzzy set. These techniques when tested experimentally provided better results than Boolean systems.

2.2 Information Overload

Information overload refers to the phenomenon of the retrieval of too many references in response to a subject search so that a user actually gets bewildered and frustrated and may choose not to go further. The problem of information overload recognized by several authors such as Markey (16), Lawrence (17), Lynch (18), Mitev and Walker (19), Wibberly and Daugherty (20) may be due to the following reasons:

1) The search term may be too broad.

2) The number of items indexed under a given term might be increasing, as an online catalogue database grows. This increase may be more rapid in a keyword approach then in a subject heading approach.

3) Truncation of terms as compared to exact search terms results in higher recall.

4) Boolean OR operator often created the problem of information overload. For example, a request 'A or B or C' will retrieve documents indexed by any one of these terms as well as documents indexed by all of them.

3. Subject Access in OPACs: Possible Solutions

To remedy the above problems, many studies have been undertaken. The following trends of research are discernable.

3.1 Improvements in Search Techniques
3.1.1 Word Stemming

Walker (21), while working with OKAPI (Online Keyword Access to Public Information), showed how word stemming techniques could improve subject searching. The stemming process involved two steps. In the first step, weak stemming, regular English plurals are reduced to singulars, 'ing' and 'ed' are removed. The second stage - strong stemming - removes a fairly wide range of suffixes. The search procedure involves taking the words of the user's input, subjecting them both to weak and strong stemming and feeding all the resulting terms into a combinatorial search.

3.1.2 Providing an End User Thesaurus

Karen Markey (22) described the usefulness of displaying the structure of LCSH to enable an end user to find an appropriate controlled vocabulary that could describe topics of interest, irrespective of the fact whether they are able to match the terms they enter, with the online catalogue's controlled vocabulary or not. Bates (23) argued that providing assistance in the form of a thesaurus to the end user is an essential one in an online environment, where the basic requirements of subject searching is to identify an exactly correct LCSH to retrieve anything. However, an end user thesaurus should be distinct from an indexer's LCSH thesaurus, which - according to Bates - could easily confuse naive users, as the symbols, like 'x', 'xx', and scope notes are meant for indexers and not for the end user. A thesaurus designed primarily for the user would address the questions and confusions encountered in searching. If the same thesaurus were expanded and enriched as a front-end database, a super thesaurus, as it might be called, could contain an enormous variety of entry terms, displaying hierarchical relationships. This, along with other features, would enable the searcher to decide on the best terms for a given search.

3.1.3 Extending Search to full Bibliographical Records

Search capabilities may be improved if not limited to subject headings and titles only but extended to other fields of the bibliographical record also. A field by field enumeration of the areas in the MARC record that are useful for subject or topical information was given by Markey (24).

In another study by Connell (25), segments of the bibliographical records were examined to determine their potential for retrieving the books. The combination of approaches used to simulate manipulations of the data in the record increased recall by 20%. It goes on to suggest that the interface between the users and the content of a system be designed in order of defined priorities, such as searching by keywords in subject fields, inverted headings and headings with parenthetical qualifiers.

3.2 Improvements in Indexing Techniques
3.2.1 Enhancing Subject Headings

Numerous studies on subject access to OPACs have pointed out the deficiencies in LCSH. However, subject searching might be considerably improved if the words taken from the table of contents and indexes of the books could be added to supplement LCSH. This line of research, suggested first by Atherton (26) and followed recently by Byrne and Micco (27) showed a significant

increased retrieval by 300 percent, when an average of 21 multiworded terms from the table of contents and/or back-of-the-book indexes were added to the 653 field in the MARC records for each book. In another study, Schabas (26), while comparing LCSH to LCSH plus title words, reported an improved recall of 14.7%. Following the same line of research, Cousins (29) demonstrated that both natural language and PRECIS enhanced records and provided an increase in recall compared with unenhanced MARC records.

3.2.2 Use of Traditional Classification Systems

Traditional classification systems are used in online searching advantageously in three ways. In the first, direct classification search method, the user enters a class mark and the system displays relevant records for documents entered by that number or near it. In the second method, using classification as a linking device, a suitable subject heading is found from the index, the class number attached to these headings are noted down and then used to locate bibliograpahic records from the classified catalogue. This, however, does not obviate the need for constructing subject indexes, nor does it help people in locating appropriate subject index entries. However, the classification schedules are themselves a list of subjects and the indexes to the schedules are fairly good subject indexes. This capability of classification for use in OPACs as a third method, was realized way back and was emphasized in CLR studies but the real impetus to undertake research in this direction was provided in 1984 when DDC was made available in machine readable form. Consequently, certain interesting studies were undertaken in the USA. The first, conducted by Karen Markey (30) at OCLC, is known as 'DDC online project', in which DDC was used as a searchers' tool for subject access, browsing and display in an experimental online catalogue. The result of the project indicated that the DDC enhanced subject access by providing new subject searching capabilities that are not possible through the alphabetical and keyword search in existing catalogues. It also permitted browsing display of the class numbers, where required and retrieved items are located. Another project under the direction of Diane Vizine-Goetz (31) at OCLC aims at online classifying with additional facilities for keyword searching, hierarchical browsing and multiple display options. Yet another one, under the supervision of Elaine Svenonius (32) was primarily designed for catalogue users. An experimental classification interface called 'Dewey Online Retrieval System' (DORS) consisted of four components, viz.:

1) a database comprising the DDC 700 (Arts) schedules, Ed.20
2) a database of bibliographic records
3) a database of LCSH created by collecting subject headings assigned to bibliographic records in 2)
4) a chain index to the schedules created automatically by extracting significant terms from the schedule captions and relative index.

The interface provides vocabulary enhancements, supports call number searching, facilitates global browsing and enables the user to navigate easily and effectively through classification. DORS, however, is yet to be tested in OPACs.

In a rather different approach, Larson (33) showed how classification clustering combined with probabilistic retrieval techniques could provide an effective natural language search technique. Generally the class number of a particular item in an OPAC is treated as just another keyword, assigned to that item. In this technique, however, class numbers extracted from MARC records are used to increase the number of terms associated with an individual record, the additional terms being analogous to 'use' and 'RT' references in a thesaurus, directing the user to the controlled vocabulary of concepts represented by class numbers. Thus, the class clusters function somewhat like Bates' "end user thesaurus".

3.3 Improving Searcher-System Interaction
3.3.1 Developing User-Friendly Interfaces

A user interface is primarily concerned with the interchange of information between searcher and the system. A well designed and user-friendly interface not only covers the idiosyncrasies of the search and retrieval mechanisms but should also increase the browsability through subject headings, class numbers and keywords, and thus plays a formidable role in influencing a user's opinion about a system. As it happens, an interactive type of front end interface obviates the need for learning a cumbersome conventional command language. This is done either by reducing the number of command options available to users or by standardizing the command language for online catalogues (34, 35). The 'point and click' capability of a Macintosh personal computer with its HyperCard software has been used by Case et al (36) and Coons (37) to develop more interactive front-end interfaces, known as BiblioMac and MacPac respectively. In a rather different approach, the same capabilities are being worked with at the Department of Information and Library Studies, Loughborough University of Technology by the authors of this article.

This trend of research exemplified by the work of Biswas et al (38) attempts to develop a front-end interface that could process natural language queries in information retrieval systems, allowing the users to search by subject without understanding 'search strategy' or 'search logic'. The interface makes it possible for users to define their own interpretation of linguistic terms, the interactive nature of the system can help the users to improve the response to a query. The suggested system overcomes some of the drawbacks of Boolean combinations, especially when dealing with partial matches. It is also possible to build user profiles in the system, so that it responds differently to the same request initiated by vastly differnt user characteristics.

3.3.2 Designing Knowledge Based Systems

Knowledge based systems are part of a new generation of interrelated technologies that have the potential to tackle the subject access problems in OPACs. Micco et al

(39, 40) were attempting to theoretically demonstrate how an expert system could deal with knowledge representation and provide access to the accumulated knowledge of mankind by helping end users to refine their search strategies before going online, at least as well as skilled reference librarians. This was accomplished by means of a sophisticated user interface that includes a windowing process to build a user profile and negotiate an appropriate search stategy. Such systems are capable of increasing precision significantly without sacrificing recall.

3.4 Managing Information Overload

To manage the problem of information overload, Karen Markey in one of the CLR studies of 1983 recommended that the system should
1) alert the user to limit search features by using such parameters as language, data of publication, format, etc.
2) prompt the users to enter additional terms
3) help the user by displaying more specific terms
4) show the users class numbers corresponding to the search terms and the number of postings for each of these classes.

Svenonius (41) observed that classification could be used to screen out unwanted documents. Another method reported by Doszkocs (42) is a display of retrieved records based on term weights as in the CITE system of the National Library of Medicine. To provide a structure for presenting large retrievals, an ongoing research project, 'Managing Large Retrievals (MLR)', sponsored by OCLC, intends to investigate two approaches: 1) extending the use of limiting features, like language, formate and data of publication, 2) exploring the usefulness of library classification schemes and subject headings. From this study, Prabha Chandra (43) reports a 50% reduction of retrieved sets when a combination of English language and date was used.

4. Conclusion

As the OPAC must cater for a wide range of users, most of whom do not have skills in online searching, researchers will continue to identify the problems and find their solutions, especially in subject searching, which as of now offers more problems than promises. So far the focus has been on the recognition of problems at the indexing and searching stages but the future attempts appear to be aimed at developing user friendly interfaces and knowledge based systems, wherein users' obligations regarding 'search strategy', 'search logic', and 'knowledge of end user thesaurus', etc. will be minimized and searcher-system interaction will be maximized to achieve of what is known as 'precision without sacrificing recall' to enable the OPAC to become a 'finished perfected product' (3) - at least nearly, if not fully.

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sentation has been disregarded. Shannon and Weaver's theory disregards the role of the message recipient, the contents of the message and it equals message with information and wrongly considers information as a measureable physical entity. Originally it was more correctly designated by their creators as a "theory of information transmission". Most appropriately and still less misleadingly it should be called a "theory of the economics of message transmission. Both paradigms have led astray generations of information workers."

The above had been part of my introductory words at the inauguration session of the conference mentioned above. A report on the surprises the conference held in store for its participants will be found under ISKO News in this issue. A list of the papers printed in advance in one volume (466p.) is included under Section 06 of "Classification Literature". An extensive report on these papers and on the discussions at the conference will be published in our next issue.

Finally a word concerning the contributions in this issue: We were very happy to get an idea of what the Russian Rubricator looks like thanks to Inna GENDLINA's efforts to furnish a thorough description. - The "Thesaurification of the UDC" (5) has found another example in the work of Janne HIMANKA and Vesa KAUTTO in Finland, here with regard to the Finnish language and thus accumulating another set of experiences necessary for any further progress and perhaps the establishment of guidelines for a repeatable methodology. - Charles T. GILREATH presents his ideas on harmonization in terminology which will perhaps evoke some critical comments regarding the necessary scientific dispute in order to find the truth (which, however, may also be done in harmony)! - And last in our present series of articles we include one by Shabahat HUSAIN and Ann O'BRIEN on "Recent trends in subject access to OPACs: An evaluation", a fine survey article based on a thorough study of the pertinent literature.

This issue contains also two Recommendations as fruits of the deliberations of the past two years of the ISKO Working Group on Contents Analysis. We are publishing them in the original German version as well as in an English translation. We started to number them as more of such recommendations have already been announced by this Working Group. We do hope, however, that other ISKO Groups will become equally active soon - for the benefit of our professional work.

Ingetraut Dahlberg

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