Evaluation of Precision and Recall of Five Web OPACs of the Select Universities

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ABSTRACT

The paper presents the results of a study about the five Web OPACs of Northern Indian Universities namely, Aligarh Muslim University, University of Delhi, Jawaharlal Nehru University, University of Kashmir, and Punjab University after administering thirty three standard search terms in the field of Economics to the selected Web OPACs for discovering and retrieving information about the knowledge resources held by the respective universities. These Web OPACs were evaluated by taking into account the first twenty results pertaining to each 'search query' for estimation of relative recall and precision. The study reveals that 'Mean Relative Recall' falls in a low range in relation to precision.

Keywords: Economics, retrieval efficiency, recall, web OPAC-academic libraries

1. INTRODUCTION

An 'OPAC' is an essential discovery and retrieval tool which assists to locate, retrieve and deliver the library resources to patrons efficiently and effectively. The resources of an academic or research organisation are thrown open remotely through Web-based OPAC which allow multi dimensional searches through different access points depending upon customisation, software, need or demand of an organisation. Moreover, the present Web dependent world has brought with it a new virtual retrieval tool in the shape of 'Web OPAC'. Its development is a paradigm shift from centralised systems, designed and controlled by system designers and programmers, to more and more distributed and customisable system. Commenting on its rewards over the linear search provisions, available in earlier form of physical catalogues, it is noted that users were satisfied to a great extent with OPAC in early nineties but the situation has changed drastically with the popularity of Web search engines which provide an opportunity for easier, quicker and virtual means of finding information about resources[1]. An increasing complexity in the evaluation of Information retrieval (IR) in general and Web OPAC in particular is visualised due to the changing user needs in IR world[2]. Web OPAC have caught eye of the research world from time to time in order to increase the efficiency and effectiveness of the information retrieval system for an increased precision. But, Web OPAC research is primarily concerned with performance from the system perspective[3] to understand its efficiency and effectiveness in search, accessibility and delivery of resources of an institution. Hence, further attempts need to be to initiated for a multipronged research process to understand road blocks in retrieval efficiency of Indian university OPAC mechanism and in that series the present attempt is an endeavour to examine its efficiency form controlled vocabulary based subject access perspective in its Precision and recall estimation.

2. RESEARCH STATEMENT AND LIMITATION

The primary objective of this research here is to estimate Relative Recall and Precision of the Web OPAC and correlation thereof. However, the study is limited only to five Indian Universities in the field of Economics. The selected Universities comprise of three central universities and two state universities situated in Northern India. These are:

(a) Aligarh Muslim University (AMU), Aligarh

(b) Jawaharlal Nehru University (JNU), New Delhi

(c) Punjab University (PU), Chandigarh

(d) University of Delhi (DU), Delhi

(e) University of Kashmir (KU), Srinagar

3. LITERATURE REVIEW

Although, few studies have been carried out across the globe on various aspects of precision and recall of 'Web OPAC' when one doesn't find any serious description related to evaluation of precision and recall of University Web OPAC chiefly in the subcontinent. However, different studies and their findings enlisted here help one to place the present study in its right perspective in particular being useful in estimating precision and recall from subject perspective.

'Precision' is the number of retrieved documents that are relevant to a query while 'Recall' is the number of 'truly' relevant documents that are effectively retrieved. 'Precision' is a measure of 'Soundness' of the IR system while 'Recall' provides a measure of 'Completeness' of the system[4]. Xu & Lancaster[5] has made an analysis of 205 records selected at random from the OCLC Online Computer Library Centre and have reported overlapping in the subject access points provided by the title, subject heading and classification number fields and have concluded that online catalogue outperform the card catalogue more in precision than in recall. In the same sequence, Larson[6], et al. pronounced that the controlled subject vocabulary searching has increased the precision of results and also has saved the time of the user by reducing the long lists of mostly irrelevant results often returned by overly general natural language. It is reported that some libraries in China even adopt the tagging technology in their OPAC that help users to find popular materials[7]. However, many words tagged on the catalogue are not the controlled vocabulary and therefore have decreased the precision of search results. Both natural language and PRECIS enhancement of MARC records also increase the number of relevant documents found, with PRECIS has shown a better performance[8]. In a comparative analysis of natural language and controlled vocabulary systems in Soil Sciences, Muddamalle[9] has suggested that libraries should adopt 'Keyword search' because its implementation may help to increase the recall in subject search. Cherry & Clinton[10] while making a study of five Toronto universities Web OPAC , in the context of user profiles, have reported that zero hit subject searches for user queries improve recall. However, Subject headings could prove a key component in its improvement that will also provide a greater precision in subject search in future emerging catalogues[11].

Besides, many studies revolved round Indian and Pakistani academic library Web OPAC which mainly have discussed their general features, general interface or subject interface in detail without analysing their precision or recall measures. Most OPACs in the academic set up of India offer the basic search features required by users and belong to what is often referred to as 'second-generation catalogues'[12]. The features and functions of indigenously developed web-based catalogues of academic, special and national libraries of Pakistan indicate that indigenous Web OPACs are at an initial stage of development offering basic facilities to their users. These Web OPACs are not presenting such facilities yet, which in advanced countries are being presently provided[13]. It is also reported by Madhusudhan & Agarwal[14] that six Indian IITs Web OPAC lag much behind in exploiting the full potential of the library portal and federated search facilities. The University Libraries, in Chandigarh and Punjab, it is advocated by Kumar & Vohra[15], that these institutions in collaboration with software designers should explore a mechanism to add new features in their Web OPAC e.g, faceted navigation, federated search, etc.

4. RESEARCH METHODOLOGY

The study was carried out in three stages:

(a) First Stage: The related publications available in electronic format were reviewed which helped us to evolve a suitable scale for the estimation of the values.

(b) Second stage: The five Universities having Economics as a course of academics were identified for the study.

(c) Third Stage: The University Web OPACs were accessed for the select terms from December 2014 to March 2015. Finally data retrieved was analysed to arrive at present results.

The detailed procedure adopted for the study is further given as follows:

4.1 Selection of Subject Terms

The provisions for retrieval test in the field of Economics were derived from Dewey Decimal classification 22nd edition (2003) and all terms of first order falling under 330-339 were taken into consideration. Then, the subsequent terms falling under each class of 330-339 were also taken into account and out of them, two to three 'terms' were chosen depending upon their exhaustiveness in that array and giving judicious weightage to both simple and compound isolates. In this way, each second remove of the array got a chance to have each minimum two isolates so to constitute a list of thirty three expressions.(Annexure I).

4.2 Mode of Searching Subject Terms

All Web OPACs of the selected universities offer two modes of searching, i.e., simple and advanced search. This study adopted the advanced search to retrieve the documents on a particular 'query search' submitted to Web OPAC. The Web OPACs of JNU and AMU offer subject and title approach as main access point while in DU, OPAC, it is being accessed through title and the software has adopted description option instead of subject approach and PU OPAC uses keyword instead of subject approach. In Advance Search, Boolean options (OR/AND) between Title and Subject are used for retrieving the resources.

4.3 Estimation of Relative Recall and Precision

The recall is the ability of a retrieval system to obtain all or most of relevant documents in the collection. Thus it requires knowledge, not just of the 'relevant' retrieved records but those of 'not relevant' records retrieved as well from the system. There exist no precise method of calculating 'absolute' recall of Web OPACs. However, Clark and Willet have adapted the traditional recall measurement for use in Web environment after giving it a relative flavour[15]. The study has accordingly followed this method, i.e., by pooling the relevant results of individual searches to form the denominator of the

calculations. Thus, the recall value after giving a relative flavour is defined as:

$$\text{Relative recall} = \frac{\text{Total number of hits retrieved by Web OPAC}}{\text{Sum of the hits retrieved by all N Web OPACs}}$$

In this study N is 5 (five)

If five universities are represented by A, B, C, D, and E and Hoi represent items (hits) retrieved by a particular university for a particular term(s), the formula can be expressed as:

$$Rr = \frac{Hoi}{Aoi + Boi + Coi + Doi + Eoi}$$

If hits retrieved by a Web OPAC for 'Financial Economics' are: 12, 14, 10, 11 and 16 respectively, the Relative recall of a particular university a (here represented by 'Aoi') will be as:

i.e., 12/12+14+10+11+16 = 12/63= 0.19

4.4 Categorisation of Relative Recall

The relative recall estimated from 33 (thirty three) identified terms was, for the sake of convenience, later categorised into four different ranges Table 1 to arrive at a result oriented conclusion particularly for bigger data.

Table 1. Categorisation of relative recall (Range)

S. No.	Relative Recall (Range)
1.	0.00 - 0.19
2.	0.20 - 0.49
3.	0.50 - 0.79
4.	0.80 - 1.99

On the other hand, precision is the fraction of a search output that is relevant for a particular query. Its calculation, hence, requires knowledge of the relevant and non relevant hits for the evaluated set of documents. Clarke & Willet[15] determine the relevance of these resources, on a six point 'Likert scale' which enables us to calculate precision. Likert response alternatives are widely used by Extension professionals. By the time of this article's preparation, at least 12 articles published in the 2011 *Journal of Extension* had used some form of a Likert response. In 2010, at least 21 articles published in the *Journal of Extension* used the technique[16]. The following criterion is adopted in Table 2. for giving weightage to resources of the Web OPAC.

In order to calculate precision of the Web OPACs, the study has adopted the following formula:

$$\text{Precision} = \frac{\text{Sum of the scores of documents retrieved by the Web OPACs}}{\text{Number of documents evaluated}}$$

Table 2. Score table of different documents/resources

S. No.	Score	Type of documents/resource
1.	5	E-resources, i.e., e-books, online journals, DVD, CD.
2.	4	Text and general books.
3.	3	Theses and dissertations.
4.	2	Print journals (back files included)
5.	1	Reference books, i.e., dictionary, encyclopaedia, different report, institution and government publications.
6.	0	Duplicate resource, items with incomplete bibliographical information, withdrawn resources etc.

Based on the above data, if the score of resources reaches 26, the precision (P) for a particular university (here also represented by Aoi) for 'Financial Economics' comes to 26/20=1.30

The precision estimated from 33 selected terms was later categorised into four ranges in Table 3.

Table 3. Categorisation of precision (Range)

S. No.	Precision (Range)
1.	0.00 -1.00
2.	1.01 − 2.00
3.	2.01 − 3.00
4.	3.01 − 4.00

4.5 Mean Recall and Mean Precision

The Mean relative recall and precision of selected terms was calculated as:

$$\text{Mean Relative Recall (MRR)} = \frac{\text{Sum of Relative Recall}}{\text{Total number of terms evaluated}}$$

$$\text{Mean Precision (MP)} = \frac{\text{Sum of Precision of selected terms of Web OPAC}}{\text{Total number of terms evaluated}}$$

5. DISCUSSIONS

5.1 Relative Recall

The documents retrieved (about 97%) from Economics fall in the lowest range (0.00-0.19) for KU and PU followed by DU and JNU in contrast to number of document, being lowest, retrieved in range of 0.20-0.49 by KU and PU OPACs. But, the Web OPAC of AMU show highest (50%) documents retrieval in range of 0.80-1.99 and leaving other resources for lowest range (about 12%). DU, JNU, KU and PU do not show any document retrieval in the highest range of relative recall in Table 4.

Table 4. Relative recall of five university web OPACs

	Distribution of selected terms for retrieval					
S. No.	AMU (%)	DU (%)	JNU (%)	KU (%)	PU (%)	Relative recall (Range)
1.	4 (12.12)	25 (75.75)	25 (75.75)	32 (96.96)	32 (96.96)	0.00-0.19
2.	5 (15.15)	8 (24.24)	6 (18.18)	1 (3.03)	1 (3.03)	0.20 -0.49
3.	8 (24.24)	0	2 (6.06)	0	0	0.50-0.79
4.	16 (48.48)	0	0	0	0	0.80-1.99

*The figures given in parentheses indicate percentage of search terms selected for retrieval.

Table 5. Precision of five University Web OPACs

	Distribution of selected terms for retrieval					
S. No.	AMU (%)	DU (%)	JNU (%)	KU (%)	PU (%)	Precision (Range)
1.	7 (21.21)	4 (12.12)	4 (12.12)	10 (30.30)	9 (27.27)	0 – 1.00
2.	5 (15.15)	0	1 (3.03)	6 (18.18)	3 (9.09)	1.01 – 2.00
3.	11 (33.33)	3 (9.09)	7 (21.21)	6 (18.18)	5 (15.15)	2.01 – 3.00
4.	10 (30.30)	26 (78.78)	21 (63.63)	11 (33.33)	16 (48.48)	3.01 – 4.00

5.2 Precision

The study reveals that all the five Web OPACs have least precision for subject expressions falling in range of 1.01-2.00 covering 3-18% terms only except DU. The Web OPACs of AMU and KU estimate almost equal precision score for 15-33% terms in all ranges. DU scores highest precision range of 3.01-4.00 for about 78% terms and least precision for about 9% in range of 2.01-3.00 .PU has highest precision for about 48% subjects in range of 3.01-4.00 and least (about 9% terms) in range of 1.01-2.00 in Table 5.

5.3 Mean Precision and Mean Relative Recall

While comparing the mean precision of five University Web OPACs, it reveals that DU scores the highest mean precision (3.23) followed by JNU (2.97) and PU (2.41) respectively. AMU obtains (2.29) while KU receives the lowest mean precision (2.10). On the other hand, AMU has highest mean relative recall (0.65), followed by JNU (0.14) and DU (0.10). The Web OPAC of KU and PU maintain low recall (0.03) each.

Further, upon computing, the study reveals that in all five Web OPACs get mean relative recall which is much low compared to mean precision value (Table 6). It does not exhibit any significant correlation but as usual, it demonstrates that every low Mean Recall has higher precision but DU OPAC shows the highest precision and KU gets lowest precision.

Table 6. Comparison of mean precision and mean relative recall

	Select University web OPACs				
	AMU	DU	JNU	KU	PU
Mean precision	2.29	3.23	2.97	2.10	2.41
Mean relative Recall	0.65	0.10	0.14	0.03	0.03

6. CONCLUSIONS

The retrieval efficiency of the Web OPACs, in terms of relative recall and precision, is not quite adequate. The Relative recall is also not satisfactory for the most of the university OPACs when precision is comparatively better with Delhi University OPAC exhibiting highest precision. Secondly, as usual, the precision increases to some degree with every increase in recall value. Therefore, to achieve more precision and flawless recall, the professionals of information management and software management need to identify shortcomings in the syntax and semantics of vocabulary management and call for increase in the efficiency of knowledge resource handling approach through specific subject expressions by the patrons. It seems that Indian professionals do not either invest much in making an appropriate choice and take less care in selection of specific Subject Headings or rush data entry process in the name of automation and digitisation without following the right syntax of standard terms in an adequate manner. Beside, the changing scenario of information seeking might have also contributed in poor performance of retrieval efficiency and hence each element or fragment demands more serious thought attention and leadership in furthering better education and research in this direction.

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Annexure 1
Search Terms of Economics

I	Labour Economics	xii	Renewable Energy Resources	xxiii	Debt Management
Ii	Women Workers	xiii	Co-operatives	xxiv	Public Expenditure
Iii	Industrial Occupation	xiv	Banking and Credit Cooperation	xxv	International Economics
iv	Labour Management	xv	Consumer Cooperatives	xxvi	Multilateral Economic Cooperation
v	Financial Economics	xvi	Benefit Societies	xxvii	European Economic Community
vi	Banking Services	xvii	Socialism	xxviii	Production
vii	Monetary Policy	xviii	Marxian Systems	xxix	Economic Fluctuation
viii	International Investment	xix	Democratic Socialism	xxx	Business Enterprises
ix	Economics of Land and Energy	xx	Fascism	xxxi	Micro Economics
x	Real Estate Market	xxi	Public Finance	xxxii	Income Accounts
xi	Public Land Survey	xxii	Income Tax	xxxiii	Saving and Investment